5-1982

Plant Science Building, College of Agriculture, Clemson University

Mary L. Bercik
Clemson University

PLANT SCIENCE BUILDING

College of Agriculture

Clemson University

Mary L. Bercik

A terminal project submitted to the Faculty of the College of Architecture, Clemson University, in partial fulfillment of the requirements for the degree of Master of Architecture.

[redacted]

Mary Lynne Bercik

Approved:

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Committee Member (adv)

[redacted]

Head, Dept. of Architecture

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Dean, College of Architecture

to my parents:

without their love, guidance, and support so many things, including this work, would not be possible.

TABLE OF CONTENTS

PROJECT DESCRIPTION

Mankind is directly dependent upon many species of the plant Kingdom for food and fiber products. Plants are essential for the population's nourishment, health, and comfort. The food and fiber of plants are produced as a result of complex physiological processes, acting under the influence of constantly changing conditions. Through acquisition of knowledge and research efforts, an effective and efficient program can deliver essential information to farmers who produce the food and fiber for the population. The role of Clemson University's College of Agriculture is to satisfy this need.

The Plant Sciences are represented by four departments in the College of Agriculture: Agronomy and Soils, Entomology, Wildlife and Fisheries, Horticulture and Plant Pathology and Physiology. The present facilities of these departments are inadequate in terms of space and equipment, and being located in different buildings, the departments are unable to establish a coordination of their research and teaching facilities.

It is the purpose of this terminal project to research the physical needs of these four departments and develop a design proposal for a new Plant Science Building for Clemson University.

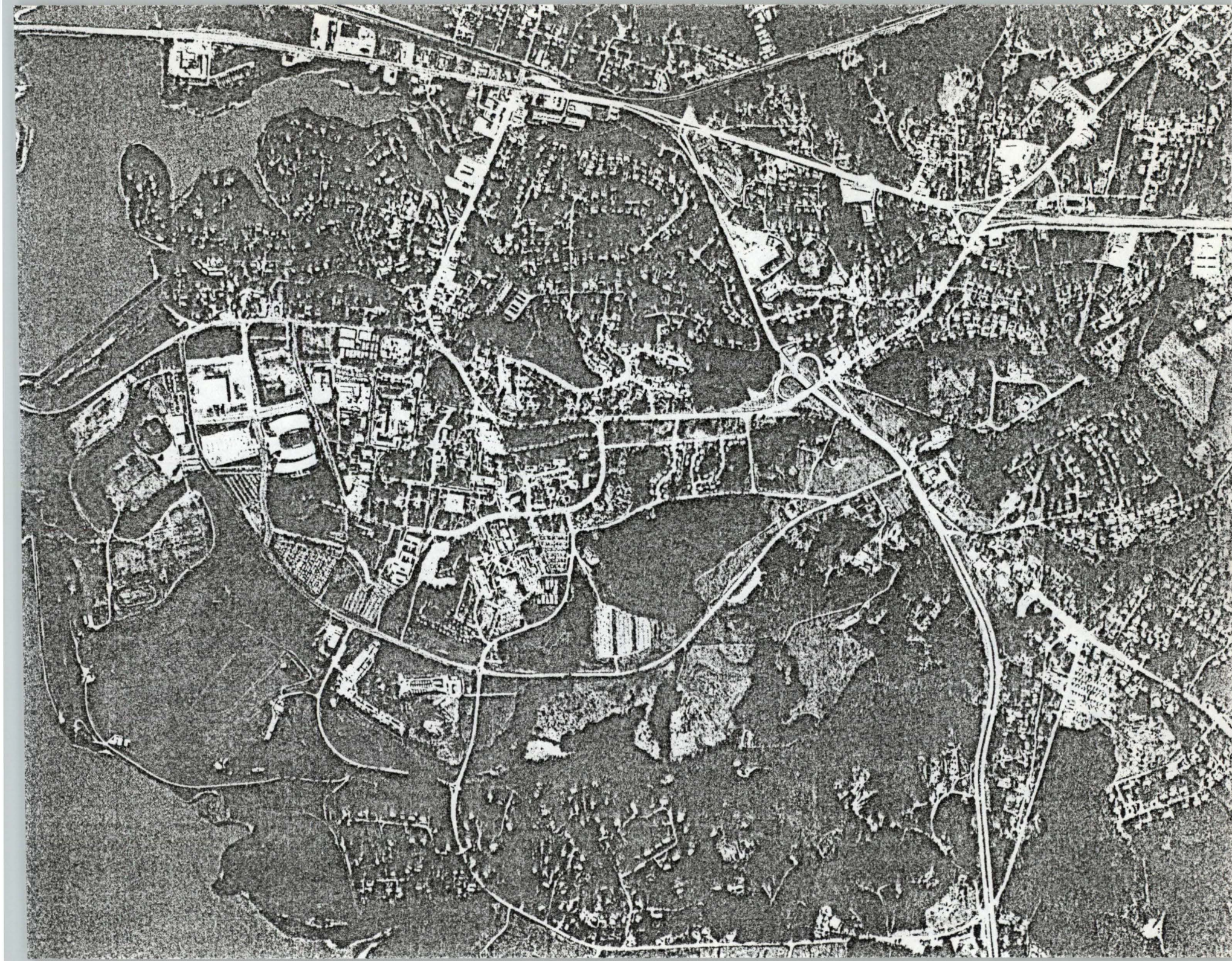
CLEMSON UNIVERSITY

SETTING

Clemson University and the city of Clemson are located in the rolling piedmont section of South Carolina. The climate is temperate with hot, humid summers and mild winters. Great southern hardwood and pine forests are the major natural flora. An extensive woodland area still surrounds Clemson.

A major physical feature of the Campus was established in 1963 with the completion of the dam at Hartwell, Ga. The resulting Lake Hartwell directly joins the campus to the west and south, and the town to the north and west. A series of dikes preserve some low-lying areas of the campus from flooding, and the entire shoreline is under the jurisdiction of the U.S. Army Corps of Engineers.

Although the nearest Interstate Highway to Clemson is some ten miles southeast of Clemson, the town/university is served by two major highways, U.S. Highway 76 which runs from Clemson to the southeast toward Interstate 85 and the city of Anderson. U.S. Highway 123 runs from the northern Georgia region to Greenville; a major metropolitan and transportation center of the piedmont region.



HISTORY

Clemson University is a land grant institution which was established as Clemson College in 1889 under the Morrill Act, the student population totaled around 120.

The founding purpose of Clemson College was to regenerate the South's prosperity through offering education in the most modern agricultural and technical science curricula. Sikes Hall was originally designated as the College of Agriculture with Tilman Hall functioned as the library and academic center. The newly founded town to the north and the Calhoun Mansion to the southwest limited expansion of the campus in these directions, so as new facilities were needed they were built along the edge of the ravine to the east. The movement of the Library in 1925 to Sikes Hall shifted the academic center of campus and gave further impetus to this eastern development. Long Hall served as the College of Agriculture Building from 1930 to 1950. To this day some departments of the college remain in this location. The R.F. Poole Agricultural Center was constructed on the outskirts of the campus to consolidate all the departments of Agriculture into one complex. In 1965, the Muldrow Cooper Library was

built in the emerging center of the campus. Along with bridging the east and west fingers of campus, the library became a strong center for a campus developing to the south and served as the academic focus of the University.

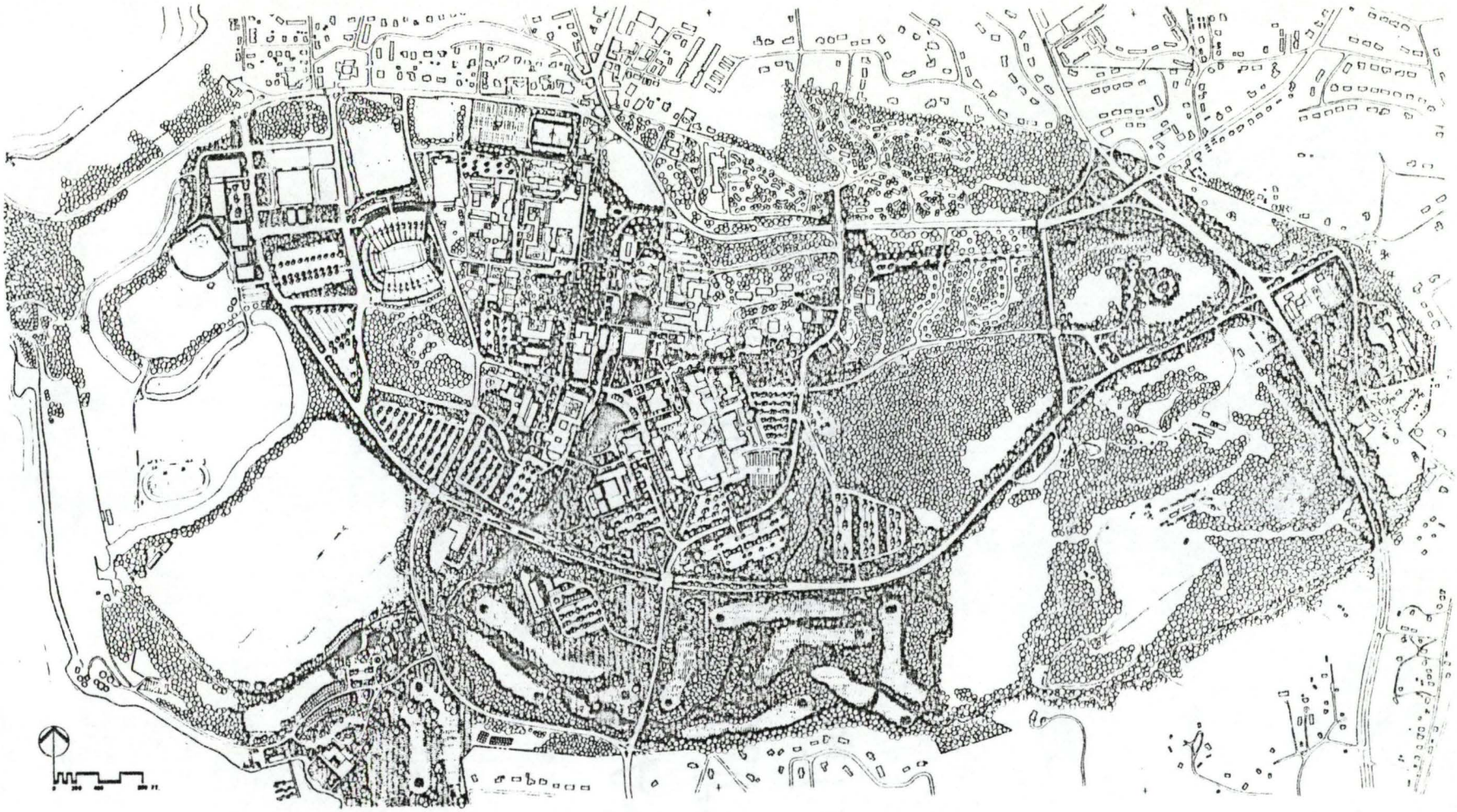
THE CAMPUS

MASTER PLAN

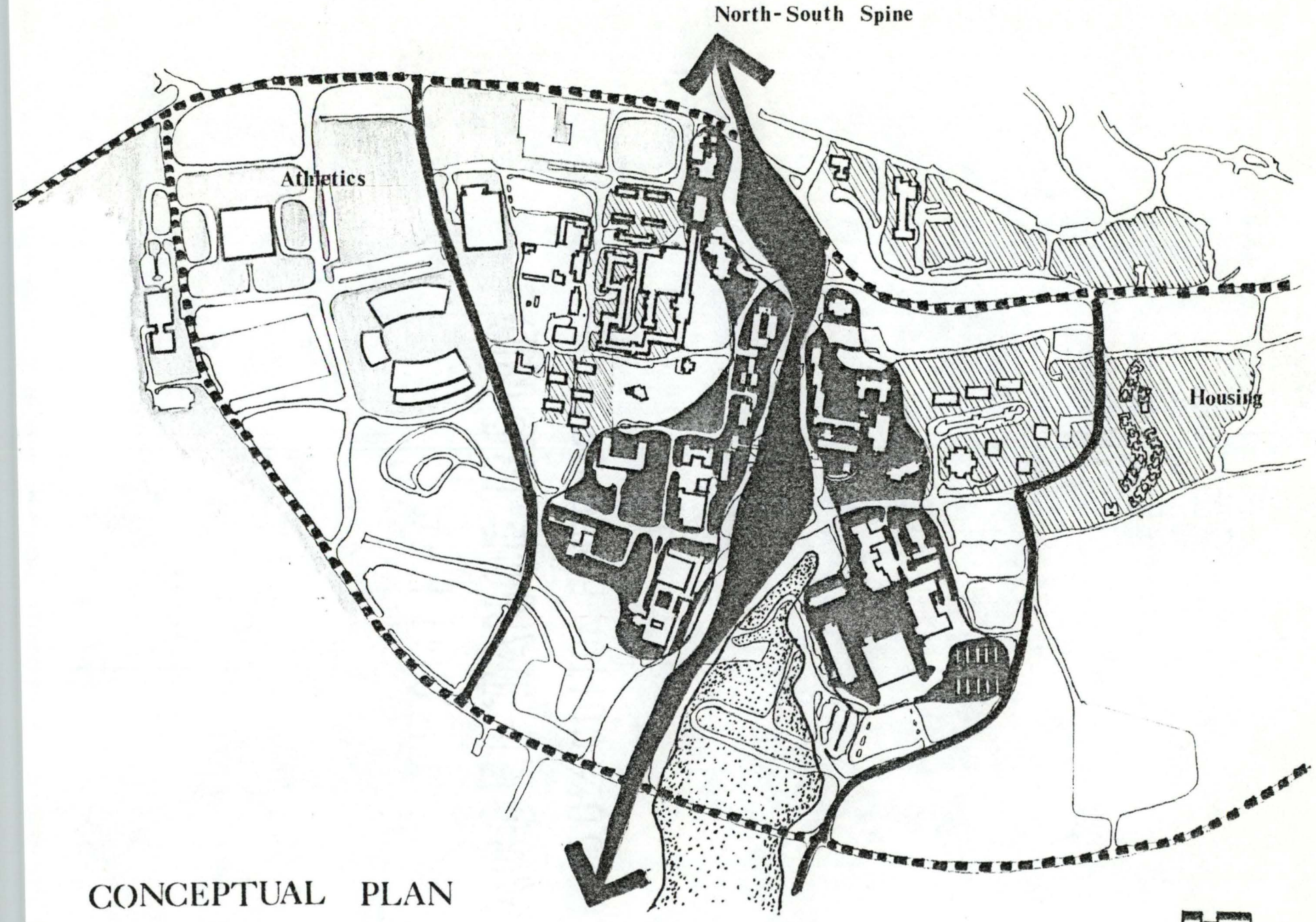
When Clemson College opened its doors to 446 male students in 1893, it is unlikely that any of the students or faculty would have predicted that the small agricultural and engineering college would grow to become a major coeducational university with an enrollment of more than 11,000 students. To meet current needs of these students and to anticipate future requirements, the university and its consultants; Lockwood Greene, Architects and Engineers, in association with Edward Pinkney Associates, Landscape Architects, have recently completed a 20-month Master Plan Study.

Unlike previous master plans, this study presents no definite picture of what the University will look like or become in the the next several decades. Instead, it was the goal of this Master Plan effort to produce a tool and a process that could be used by the Clemson community to create a coherent environment - one that is responsive to the goals and objectives of its inhabitants.

A survey of the proposed Master Plan is shown in the following pages.



Illustrative Development Plan 10



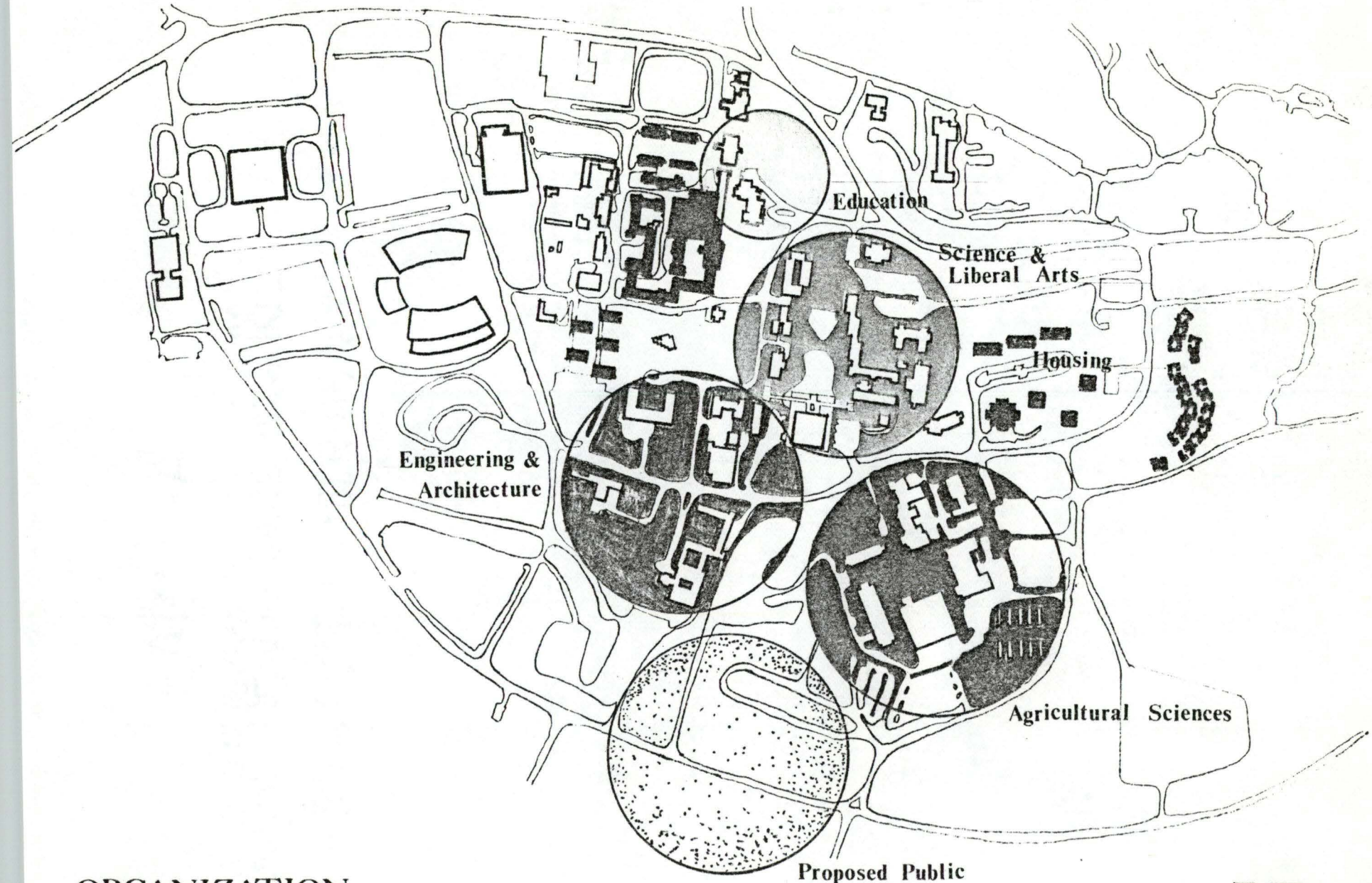
CONCEPTUAL PLAN

CAMPUS ORGANIZATION

The proposed Master Plan emphasizes campus growth along the existing north/south spine. Conceived as a major open space it would connect the city's commercial center with a future recreational area located on Lake Hartwell. All common support activities (Alumni Center, Library, reflection pond, ampitheatre, along with proposed facilities such as the Preforming Arts Center, Continuing Education Center, and the Strom Thurmond Institute) are oriented to, and located along, this organizing spine.

A natural grouping of academic elements emanate from a core of basic studies along the east and west banks of the spine. Future growth is expected to extend outward along the open space. Housing is attached to the periphery of the academic zones with areas on East Campus reserved to serve potential housing expansion.

Athletic facilities are concentrated on the campus west extreme and are of an area equivalent in size to the total academic campus. It is anticipated that the University will capitalize on its adjacency to Lake Hartwell by increasing the level of recreational opportunities attached to the Lake. A golf course, marina and clubhouse, and Alumni residences are some of the proposals for the Lakefront property at the south end of the campus spine.

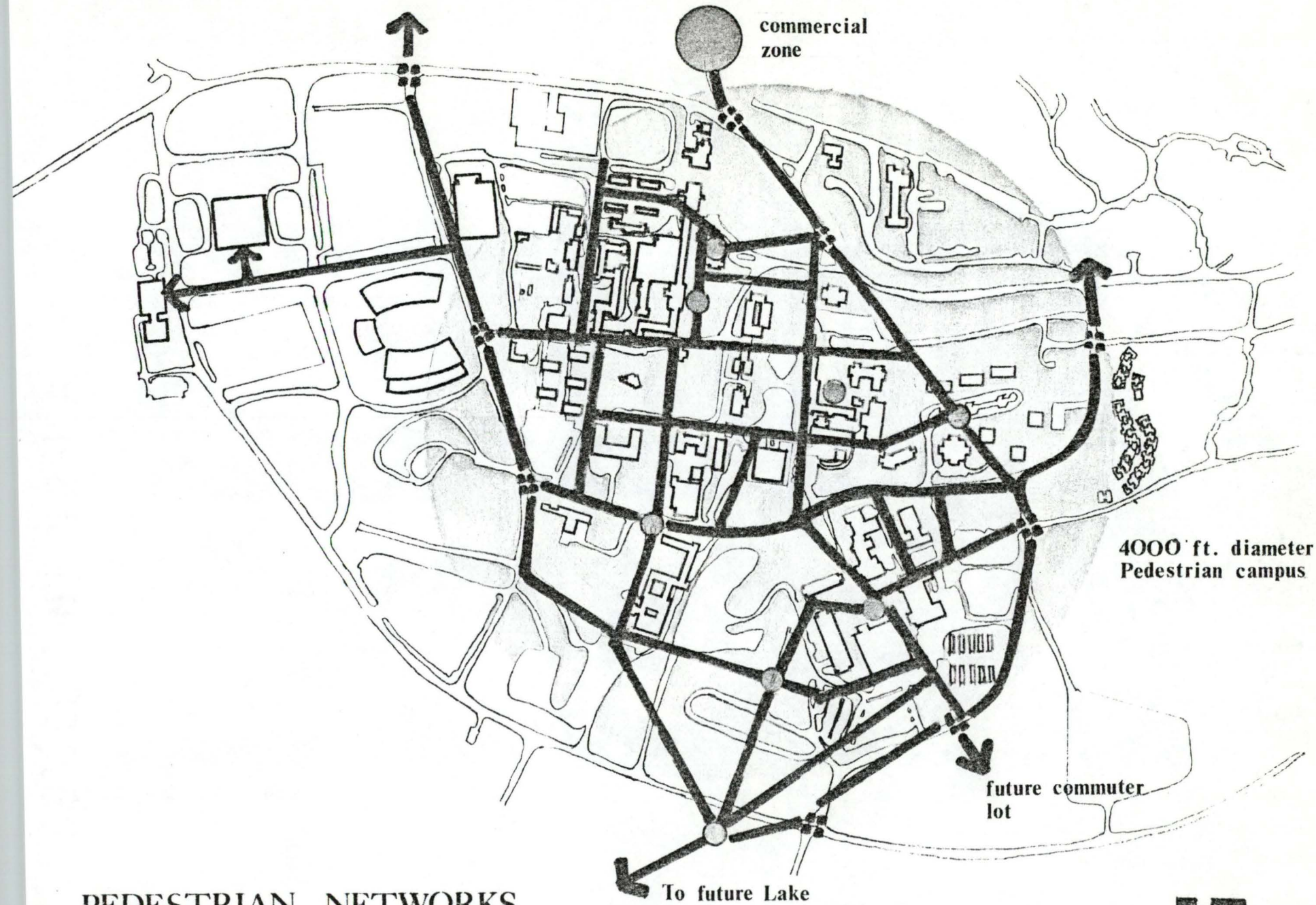


ORGANIZATION

PEDESTRIAN NETWORKS

The pedestrian network on the Clemson University campus consists of a loosely knit series of activity nodes and the walkways, plazas, and open spaces that connect them. The campus is transversed with through-streets that brings autos into direct conflict with pedestrians. In addition to being a hazard to pedestrian safety, the automobiles are noisy, take up space, and reduce social interaction in the core campus. Therefore, there is a valid need for establishing a pedestrian- oriented campus (proposed diameter 4000 feet).

The concept for the campus' pedestrian network recognizes the need to extend and strenghten the existing system and create a clear structure of activity nodes and linking pathways.



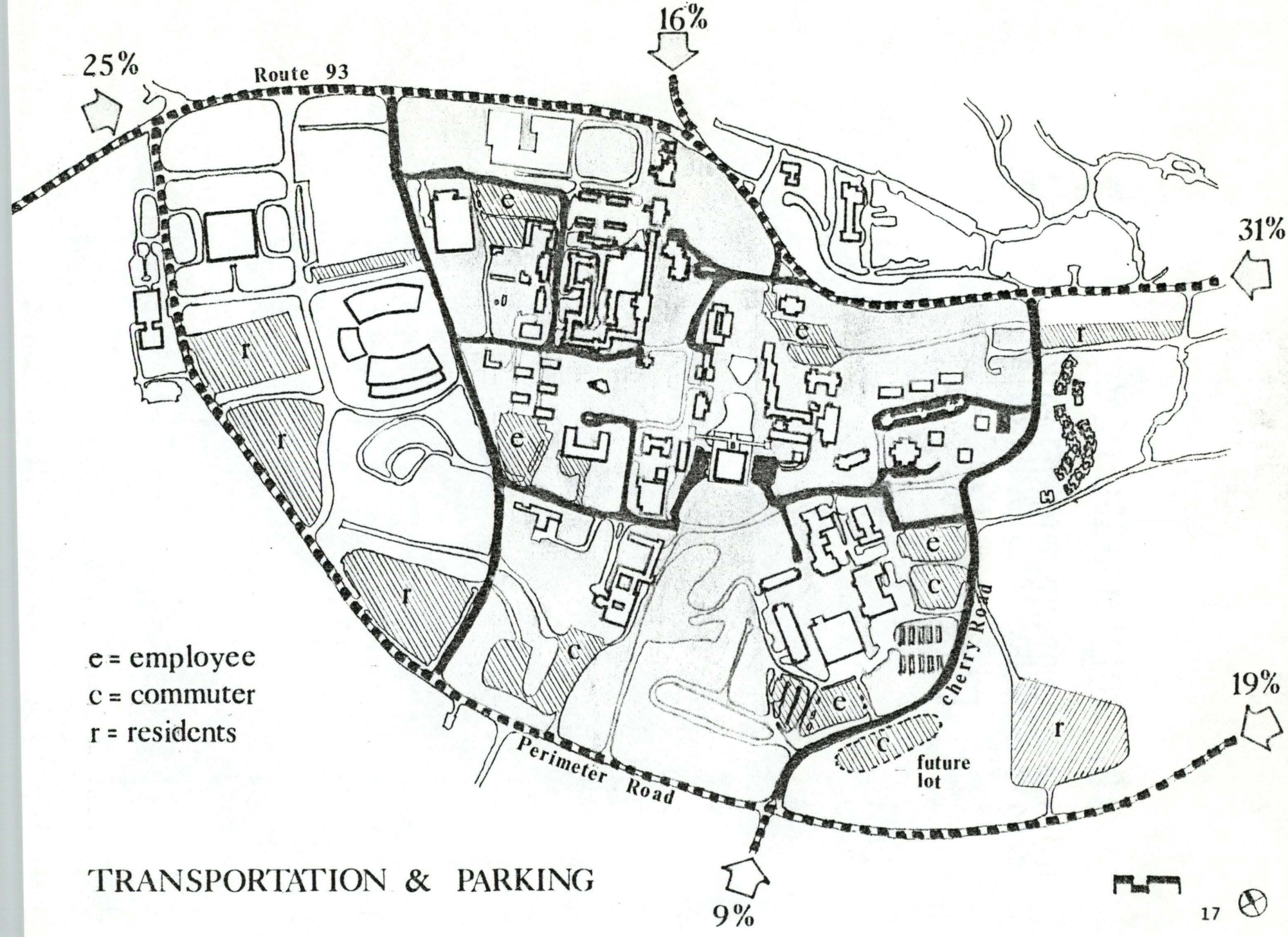
PEDESTRIAN NETWORKS

TRANSPORTATION AND PARKING

In addressing traffic and parking issues a thorough study of existing conditions were inventoried and analyzed to determine future options and improvements. These studies indicated that the overall capacity of the street network could be improved with minor refinements in street and intersection design, traffic controls, and location of parking lots.

The master plan calls for a campus collector road around a pedestrian-oriented academic and public service area. This road will distribute traffic to cul-de-sac or capillary roads servicing the main campus. Additionally, the collector road would provide the framework for future bicycle lanes, a mass transit circuit, and on-street parking for special events.

Existing parking is planned to be redesignated to alleviate distribution problems. All parking within the collector loop would be reserved for faculty, staff, and handicapped. Commuter lots are placed immediately outside the loop road and resident lots are located to serve specific areas of student housing. Noteworthy is the proposed commuter lot south of the Agricultural Complex.



TRANSPORTATION & PARKING

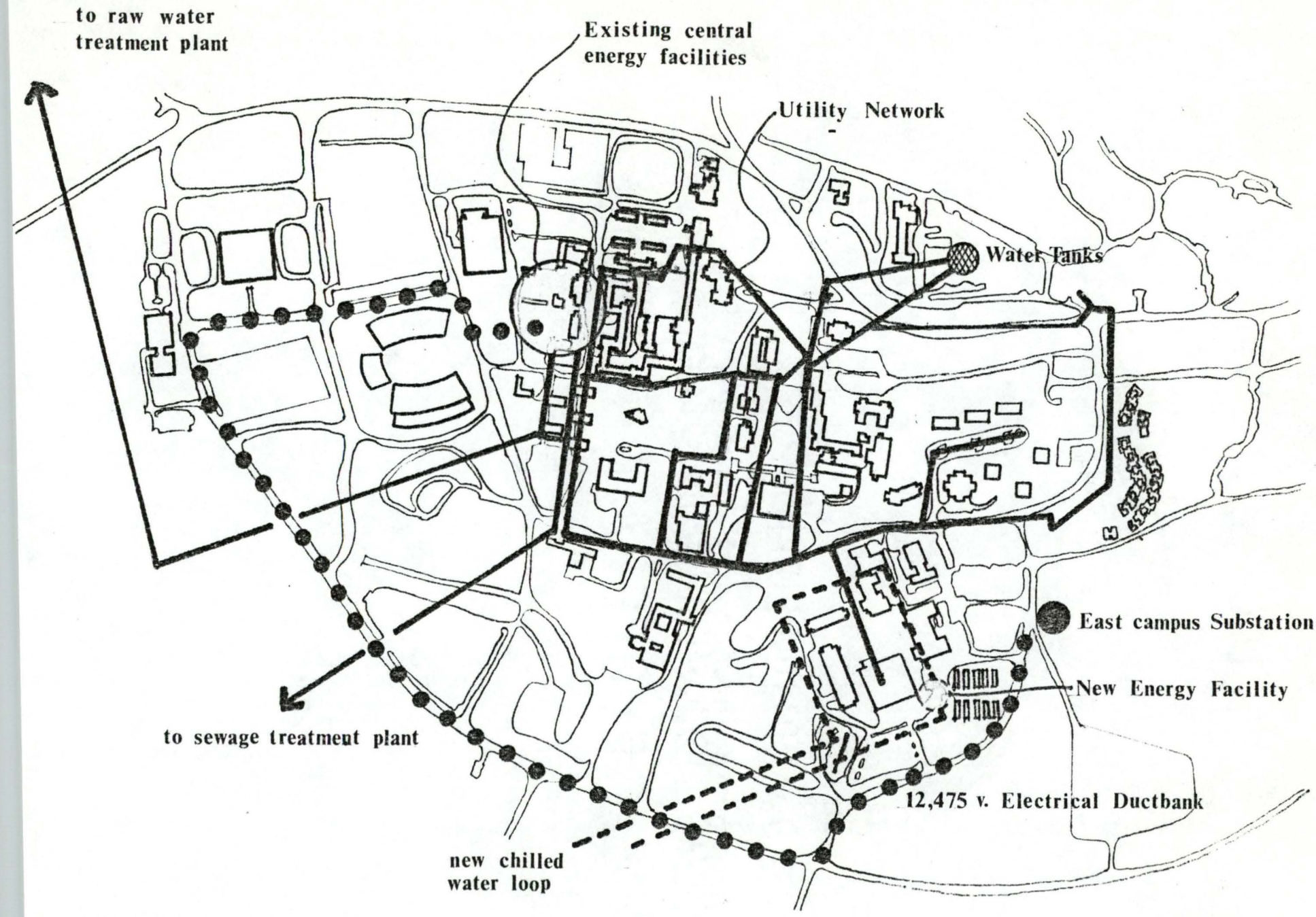
UTILITY SYSTEMS

More than any other component of the University system, the ability of the existing system to operate, expand or adapt to change can be a significant constraint or determinant to the University's development.

Analysis of existing utilities revealed that with one major exception, the University's utility systems are capable of supporting the current serving requirements of the 11,300 students that are enrolled. With minor renovations or additions to the potable water supply, storm water discharge, and waste treatment the campus could withstand an increase in the student population up to 15,000.

However, the shortage of chilled water is Clemson's most serious problem and immediate constraint to future development. To provide additional chilled-water capacity to support proposed new construction and relieve cooling inadequacies experienced in the Commuter Center, a new central energy plant and chilled water loop is proposed in the master plan. This new loop would provide service to the agricultural quadrangle and the proposed new Public Service Center area, while the existing loop would serve the proposed chemistry and engineering/ resources complex. A new

Central Energy Facility is proposed to be located southeast of the existing Plant and Animal Science Building.



UTILITY SYSTEMS

THE COLLEGE

BACKGROUND

American agricultural production ranks as one of the highest in the world. Few nations have achieved the distinguished level of individual production of American farmers. Achievements have not been easy but because of farsighted individuals instruction, research, and communication have facilitated advancements.

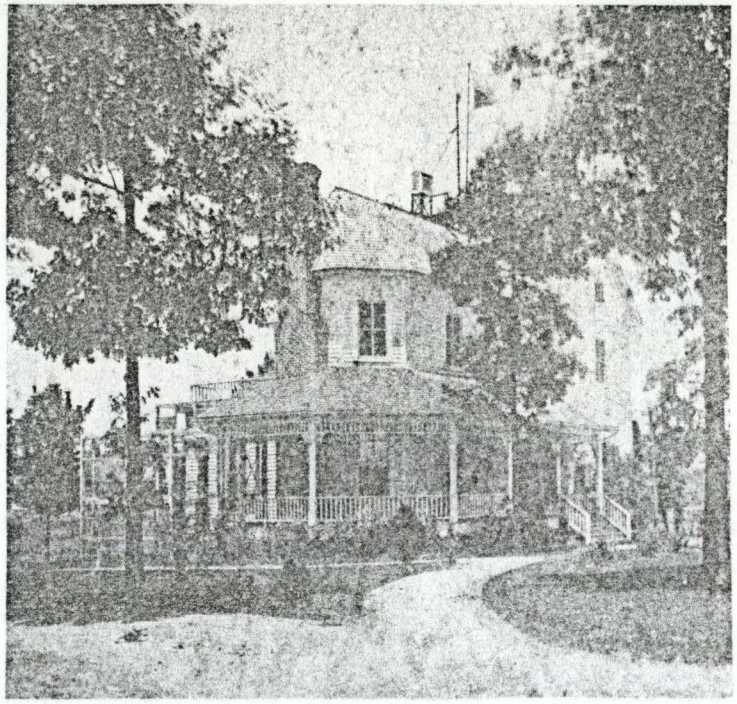
A convention of South Carolina farmers passed a resolution in 1886 advocating the establishment of an agricultural college. This resolution was given substance by Thomas Green Clemson, son of Senator John C. Calhoun, and a self taught agriculturist. Along with a bequest of 800 acres of land and $80,000 in other securities, a nucleus for the college we have today was established. Although presently a diversified university, the initial goal of Clemson College was to determine which crops could be grown successfully in this state.

The areas of Plant Science were represented by the title of Horticultural Studies. As described in the 1897-98 college catalog, the first horticultural building was a two-story frame house containing classrooms, offices, collections of various specimens, and the local office of the United State Weather

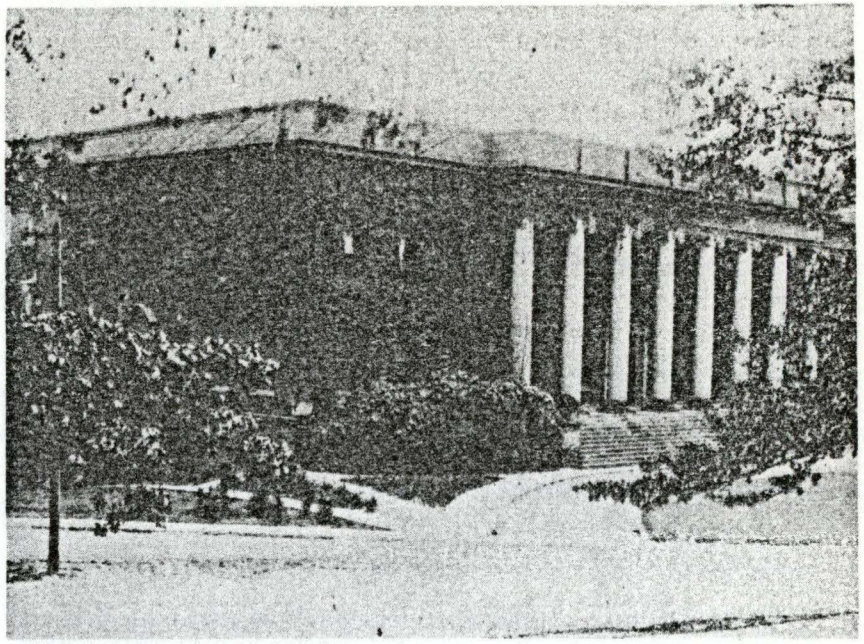
Bureau. As the discipline grew and it became necessary in 1901 separate Entomology as a separate course of study and recognition. Major research emphasis was focused on cotton diseases while teaching centered around agricultural support.

During the decade of 1910-20, agricultural studies and research at Clemson continued to expand. The total enrollment for Clemson College in 1915 was 819; 52% were enrolled in agricultural courses. The Agricultural Building (presently Sikes Hall) and the Dairy Hall housed major academic and administrative facilities. The horticultural grounds (presently the Agricultural Complex) embraced an area of 20 acres. Except for shed-type buildings, this entire area was devoted to experiments with apples, peaches, grapes, small fruits, vegetables, ornamental trees, shrubs, flowers and a nursery. Nearby was the Cannery for harvesting these fruits.

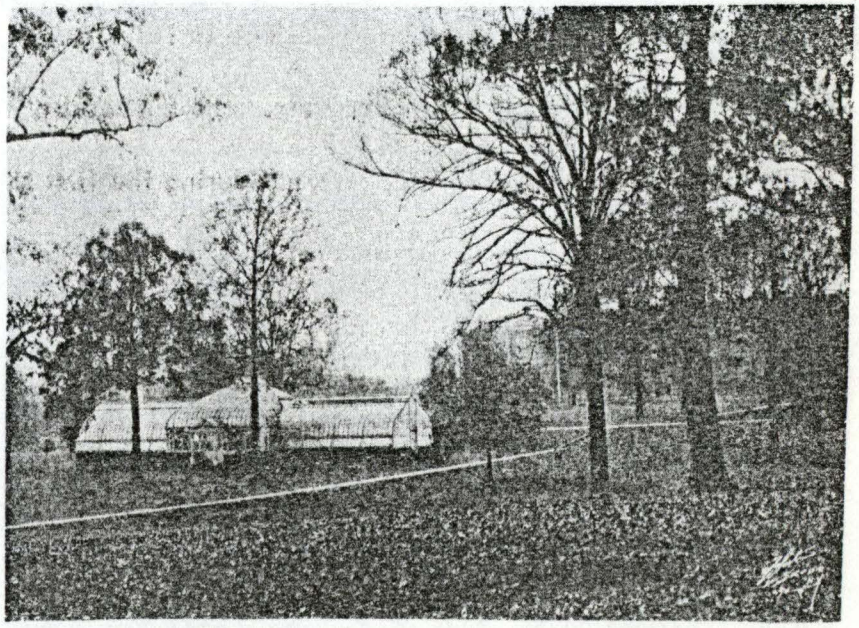
A domed greenhouse located across from Tillman Hall housed beautiful palm and ornamental plants which were not only used for teaching but also were placed in campus buildings including the president's home. During this time County Agents supervised an extensive service consisting of 250-one acre model orchards in 41



first Horticulture Bldg.



Sikes Hall, 1915



Conservatory

counties in Horticulture alone. The Department of Agronomy was formed during this pre World War I period.

One effect of World War I had was an increased appreciation for the value of research. During the campaigns for increased food production, every effort was made to apply all scientific data. This emphasized in the minds of the public the value of horticultural experimentation and caused food producers to recognize the fundamental significance of applying science to practical farming.

In 1920 the course of instruction in agriculture changed somewhat to allow students to select a course of specialization among four general branches of Agriculture: Animal Industry, Plant Industry, Agricultural Chemistry and Agricultural Education.

For example, a student who had selected Plant Industry would then major in agronomy, horticulture, or entomology. Research area was acquired through various state funds. Vegetable and truck crops dominated an experimental 75 acre plot of fertile soil along the banks of the Seneca River, one mile southwest of campus. Satellite facilities such as the Pee Dee Station and Sandhills Stations blossomed and were

oriented towards local crops with experimental varieties, fertilizer types, crop rotations, and pest research.

The late 1930's saw the dedication of Long Hall as the Agricultural Building. More campus greenhouses were constructed at this time and several satellite facilities were added throughout the state. Student enrollment was expanded and increased emphasis was given to research.

In the 1950's it became necessary to construct the R.F. Poole Agricultural Center (commonly called the Plant and Animal Science Building), 199,206 sq. ft. of building space. Its location is on the old horticultural grounds at the southern most point. Ten large (100' x 35') greenhouses were constructed to the southeast of the structure. The Center provided teaching labs, classrooms, offices, and research space and at the time responded to the needs of expanding plant and animal sciences.

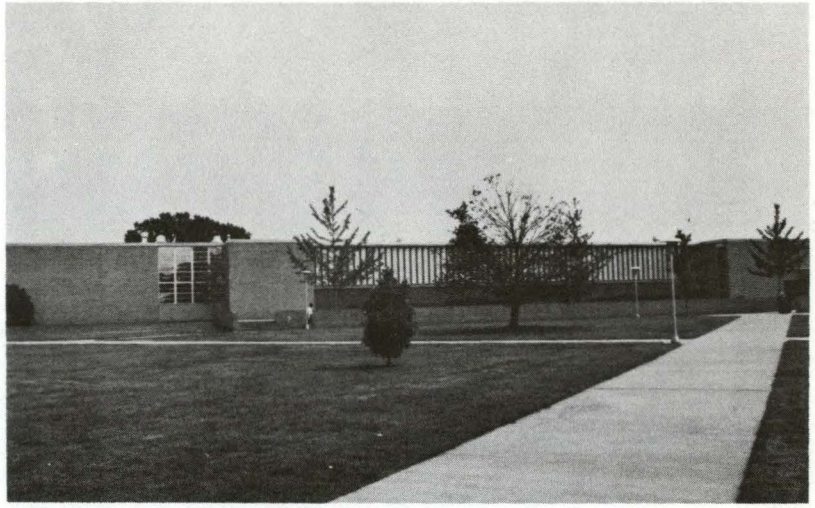
The Plant Pathology and Physiology Department was created in 1969 when the former Botany and Bacteriology Department was divided to separate these agriculturally oriented disciplines from those of botany and micro-

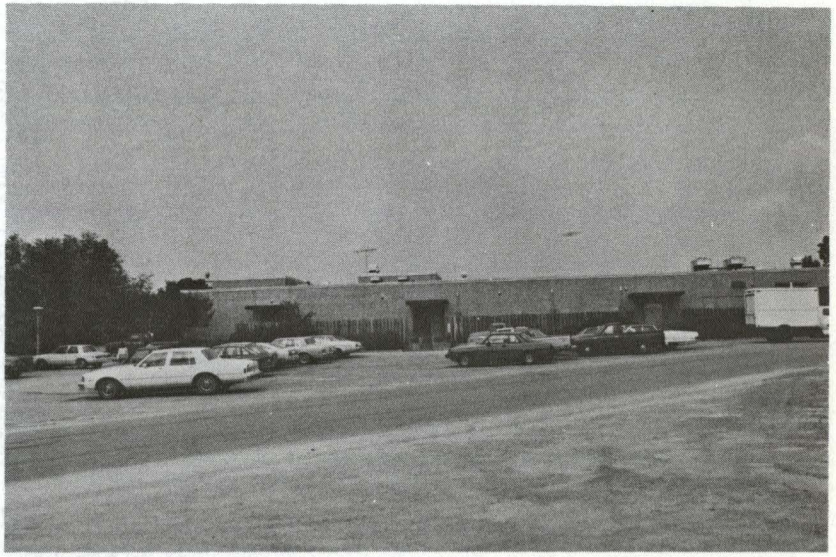
biology. Added to the Horticulture, Entomology, Agronomy and Soils, this brought to four the number of departments dealing with Plant Sciences.

During the 1970's enrollment declined to approximately 1,100 within the college. Predictions tend to lead toward maintaining this figure. Research and extension services, however, are expected to increase in size and demand.

Consequently, the emphasis in the College of Agriculture has gradually moved over the years of its existence from teaching to research, accompanied by a continuing growing state extension service.

Research has contributed in many ways to the sustained production of food and fiber crops through the discovery and development of basic concepts in the plant sciences and by transforming and implementing the concepts into usable practices for the farmer. These research results have contributed significantly to the productivity of American agriculture, which is responsible for the large volume of food exported annually in America.





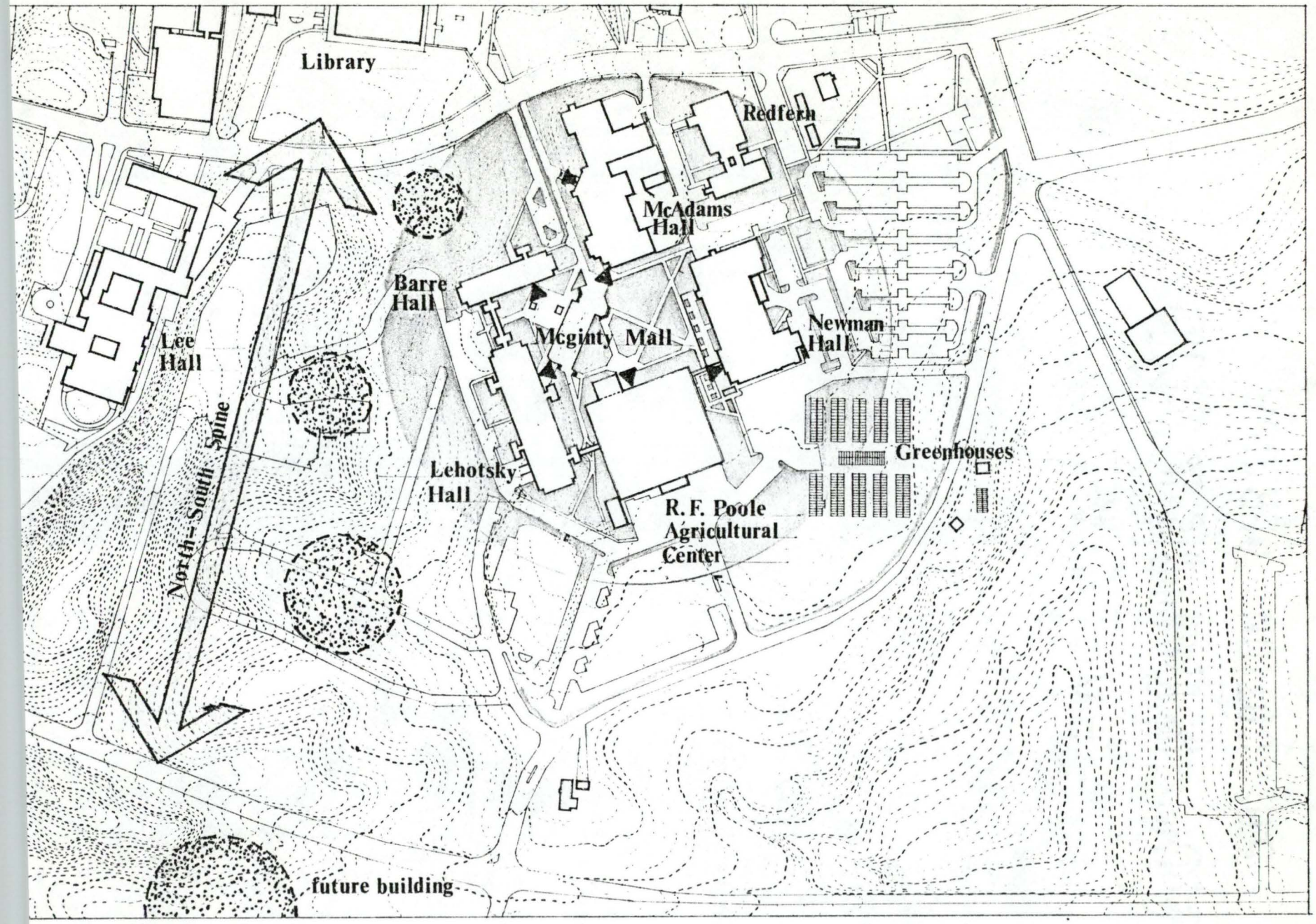
BUILDINGS

Five major buildings which comprise the Agricultural Complex: The R.F. Poole Agricultural Center, Newman Hall, McAdams Hall, Barre Hall and Lehouskty Hall. Indicative of a unit, these five buildings encompasses McGinity Mall, a sterile plaza used primarily for tranversion.

The R. F. Poole Agricultural Center, although furthest from the campus core, appears to be the "parent" building due to shear size and function. The Animal Sciences and two of the Plant Sciences are housed in this building. It also contains the computer center and supply storage in its basement.

Along with the Agricultural Sales Center, Newman Hall also contains laboratories for the Food Sciences, and the Horticultural Post-Harvest Processing Room. McAdams Hall is generally used for Agricultural Engineering. Barre and Lehouskty Hall are used by the Forestry, Parks and Recreation Departments, although the Dean of the College of Agricultural is housed in Barre Hall. Ten greenhouses and a headhouse are situated southeast of this complex.

The greenhouses, because of their large size, are difficult to subdivide for different areas of research. Additionally, their environment controls are inadequate.


Library
Redfern
McAdams Hall
Barre Hall
Lee Hall
Mcginty Mall
Newman Hall
Greenhouses
Lehotsky Hall
R. F. Poole Agricultural Center
North - South Spine
future building

BUILDINGS

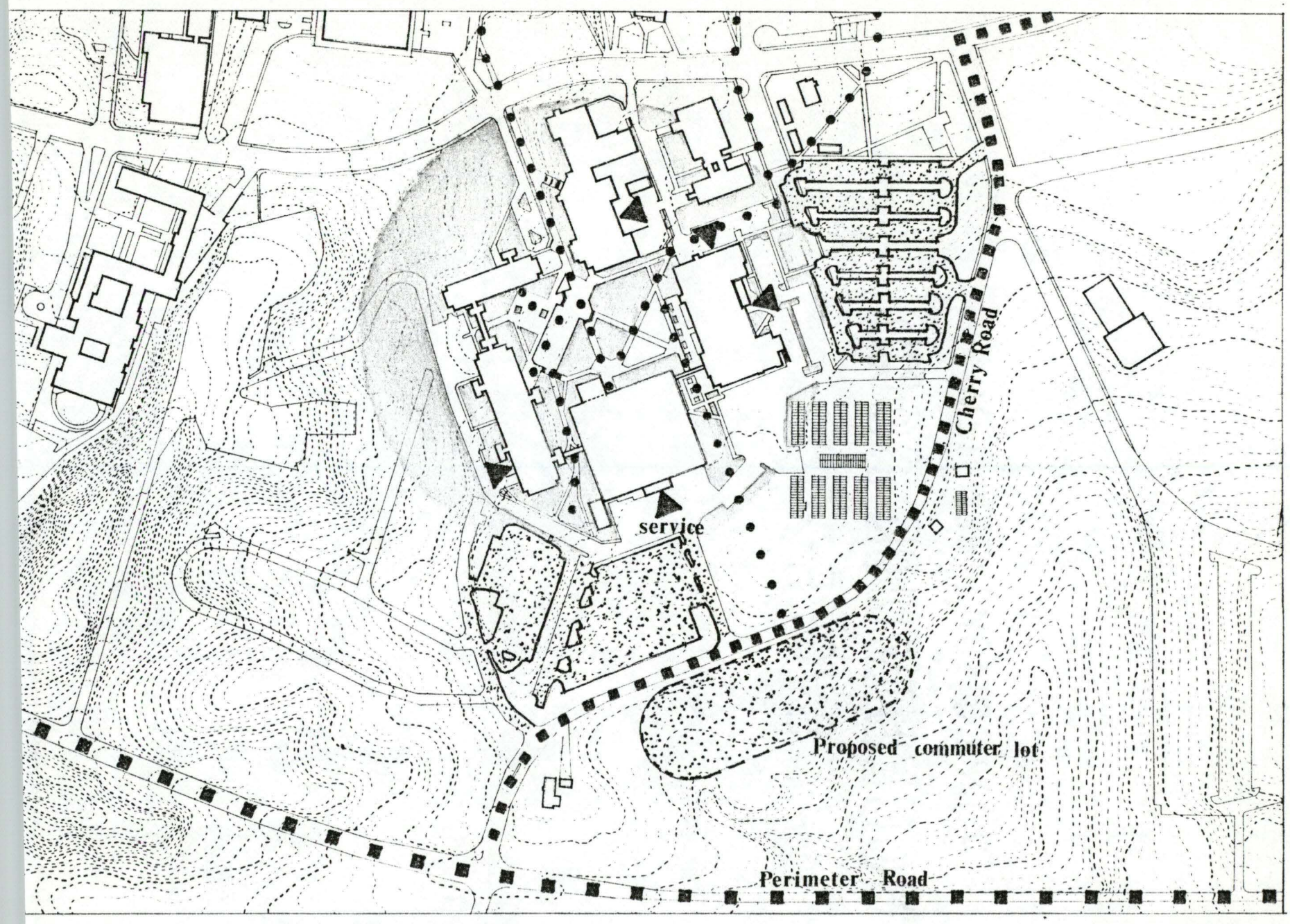
MOVEMENT PATTERNS

The Master Plan indicates that Cherry Road will become a major campus artery. Vehicular traffic along this route will increase dramatically after the completion of the Strom Thurmond Institute, the Center for Performing Arts, the Continuing Education Center and Visitor's Center. The southeast perimeter of the Agricultural Complex will take on increased importance from a visibility and access standpoint.

Service areas are generally on the perimeter of the Complex. The service court behind McAdams Hall is the only attempt at concealment.

A new commuter parking lot is proposed for south of Cherry Road. At which time the present commuter lots to the northeast of the Agricultural complex will be redesignated for faculty, employee and handicapped parking.

The primary pedestrian route is that between the main campus and McGinity Mall after which movement is disbursed into the various buildings of the complex. The proposed commuter lot to the south may be expected to generate a good deal of pedestrian traffic in the future.



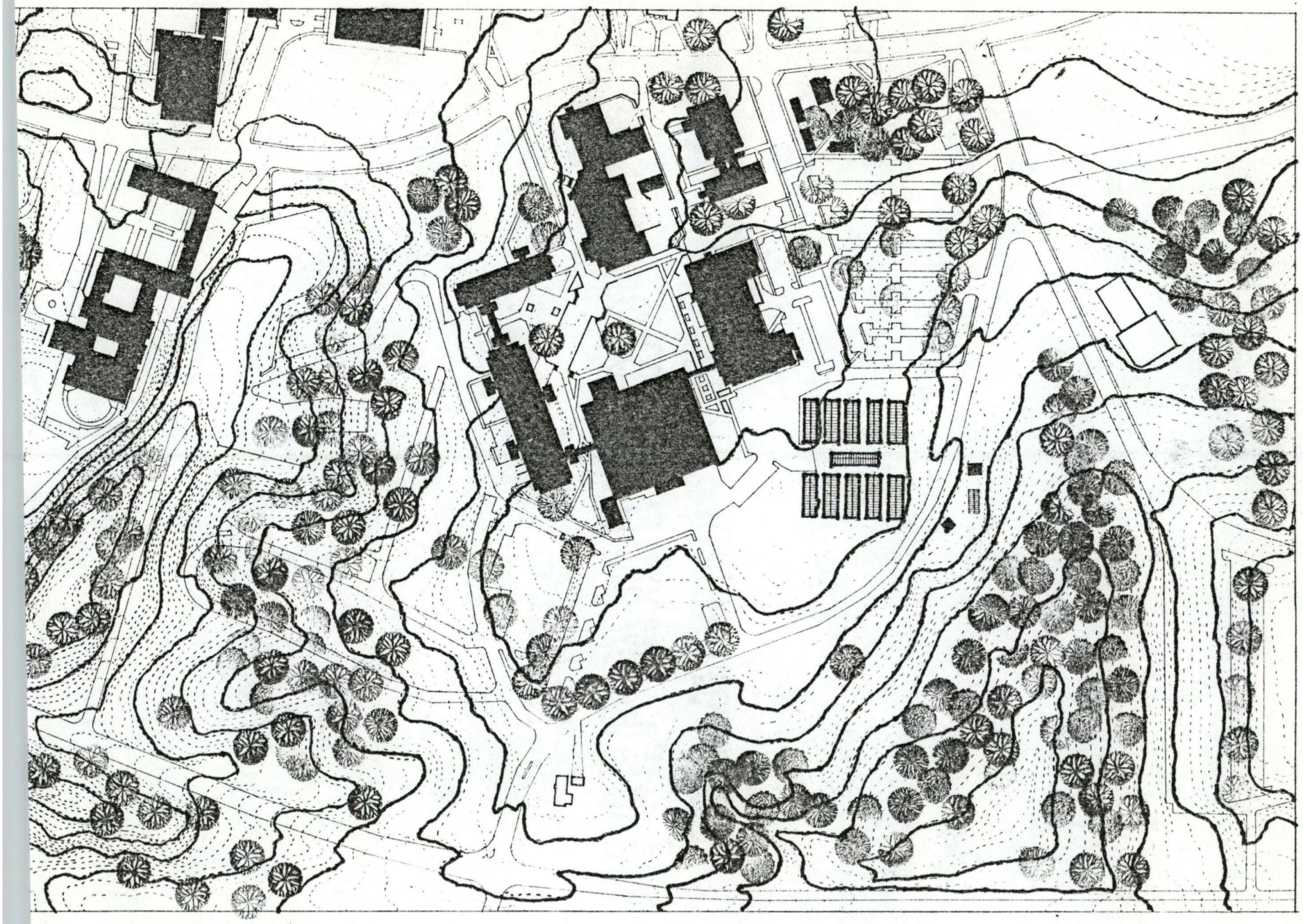
MOVEMENT PATTERNS

PHYSICAL CHARACTER

From an overall campus landform view, the Agricultural Complex is situated on the southeast portion of the east ravine bank which defines the ravine running through the center of campus. However, on a smaller scale, the Complex can be said to be located on a plateau with north, south, east, and west exposures. It was for this reason that in 1893 the Horticultural grounds were located here.

Trees are primarily of a deciduous. There is an extraordinary overall lack of ornamental plants and buses. But, most of the larger trees are of fine textures, variety and sensuous leaf canopies. The cherry trees along Cherry Road present gorgeous white blooms making them a springtime landmark.

Hydrological studies reveal that the storm water system follows the flow of gravity to the Hunnicutt Creek. Utility systems are indicative of the Master Plan, that is, proposed modifications such as the new energy facility (a 750 ton chiller with associated cooling tower) and water loop are considered as given solutions.



Physical Character

ENVIRONMENTAL CHARACTER

The location of the Agricultural Complex offers north, south, east and west exposures. Solar gain could be utilized by placing the greenhouses on the open southern portions of the site.

Elongated and troublesome building shadows are not necessarily a problem because of the low rise constitution of the complex. With some exceptions, effective tree sahde is minimal. These exceptions are: an attractive use of landscaping in the northern parking lot, and a large stand of trees south-west of the greenhouses. Also, in most cases there are only minimal attempts at lighting transitions, and consequently problems with glare arise, from interior to exterior space.

Prevailing breezes are generally from the south-west move unchecked up grassy slopes to the site. Because of the complex's composition, low velocity air tunnels are created at mall entrances.

Traffic noise of minor consequence will originate from the parking lots, delivery points and Cherry Road.

SPATIAL CHARACTER

In terms of the overall campus framework, the Agricultural Complex acts and will continue to act in the future as the terminus for the east academic spine.

Upon first view of the complex, McGinity Mall is strongly in evidence. With four of the five major buildings relating their "front" facades to this plaza, McGinity Mall would initially appear to be an activity node. The character of the mall, however, is of a transition space and students rarely socialize or settle here. The exterior space most used by pedestrians is the small outdoor space in front of the Agricultural Sales Center. Trees, canopies and benches create a more intimate and pleasant space for the influx of visitors, students, and faculty. Unfortunately this area is reached in a haphazard and unalluring manner.

There are two major defining edges to the Ag Complex. The rear (service side) of the buildings define the complex with breaks, and consequently entrances to the mall, at the facade terminations. The other edge is Cherry Road which borders the south-east and north-east sections of the site. Cherry Road will become a route of importance, so, the according modifications should be initiated to alleviate its unattractive demure.

Views from Cherry Road to the Agricultural Complex contain parking lots, greenhouses, and building service entrances. The views away from the Complex are of a rural landscape. This general characteristic may be modified slightly with the addition of the commuter lot. However, due to the steep southern slope this change will be undramatic.

THE BUILDING SITE

SELECTION CRITERIA

To understand a site and the possible ramifications of a building's placement, a careful account of all site data must be tallied. The following material will attempt to graphically illustrate this total. From this site analysis and its conclusions, it will be possible to determine the most advantageous building location. Below is a list of criteria for selecting a side:

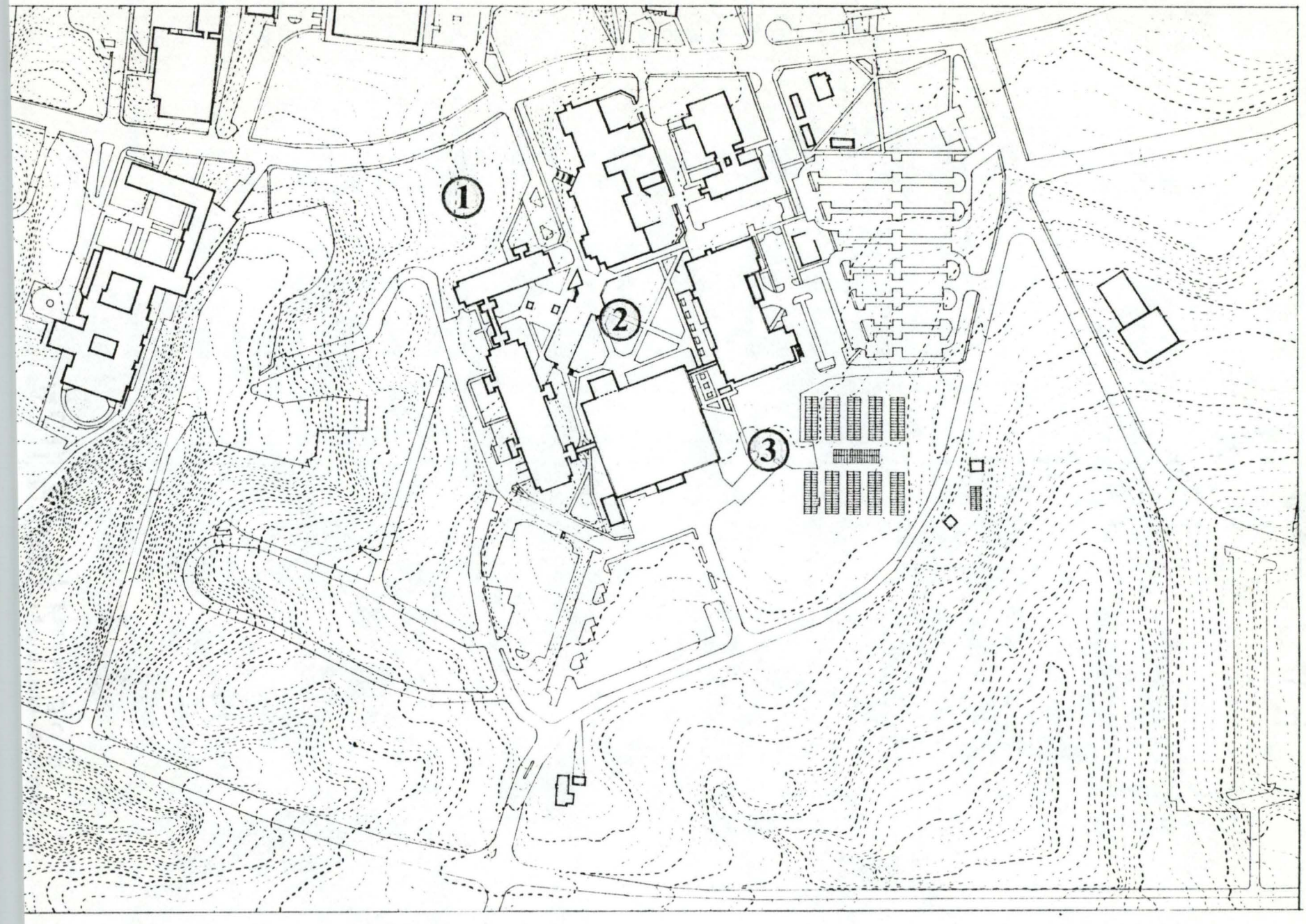
The building location should agree with existing and future campus development.

Walking distance to the building should be kept to a minimum.

The building should be accessible to a major campus vehicular traffic route (for transportation and receival of goods and equipment).

A major pedestrian pathway should be within easy access.

Vehicular traffic should not conflict with pedestrian pathways or increase on-campus traffic.



ALTERNATE LOCATIONS

ALTERNATE LOCATIONS

1

This space has been tentatively allocated to a student resource center in the master plan.

Walking distance to other parts of campus is minimized.

Although adjacent to a present vehicle route, this street will probably be eliminated in the future.

2

Pedestrian access from the main campus is reasonable.

Vehicular accessibility at grade level would be very difficult without interrupting the pedestrian nature of McGinity Mall.

A vertical building would probably be the only response to this site. Although this provide focus to the plaza it would severly limit the design response to the Plant Sciences' requirements, particularly adjacent greenhouses at grade level.

3 The site is not inconsistent with any aspects of the proposed Master Plan, except that it would require integration of the proposed energy facility with the building.

Walking distance to the main campus is maximum of the three sites. However, it is very convenient to the proposed commuter lot.

A present and future major vehicular route, Cherry Road, is adjacent to the site.

CONCLUSIONS

Site Three was chosen to be the most advantageous building location. Preliminary design conclusions revealed that the building mass should be played down in some manner as not to infringe on the Agriculture Complex's spatial hierarchy.

THE PLANT SCIENCES

CHARACTERISTICS

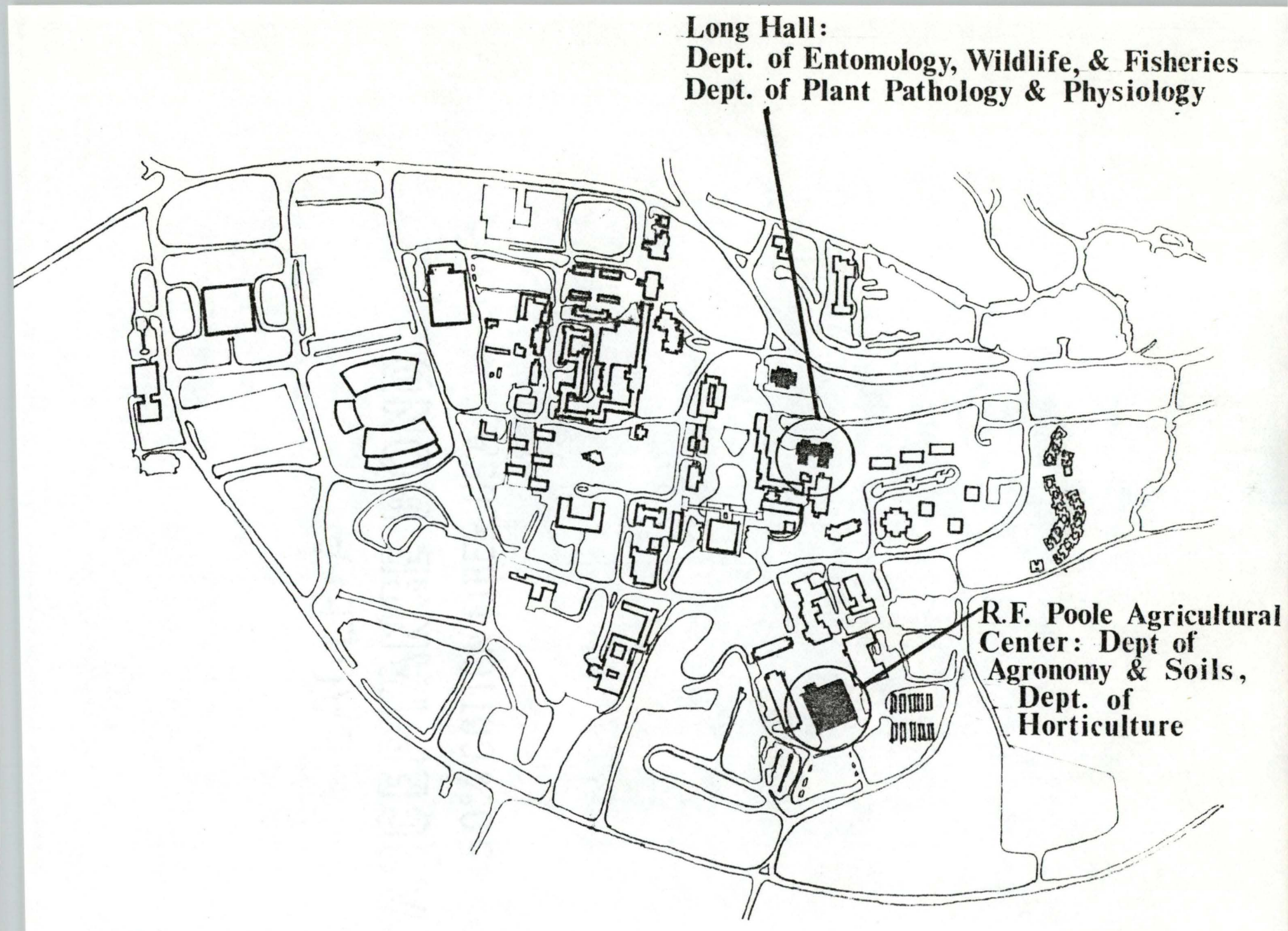
Simply, the Plant Sciences deal primarily with plants. The College of Agriculture has divided the Plant Sciences into four distinct departments.

The Department of Agronomy and Soils centers around the science and practice of field crop productions, soil management, and microclimatic manipulation. Agronomy involves the conversion of basic scientific and technical facts into useful and useable systems and solutions of practical production problems. Presently, the department's facilities are housed on the second floor of the R.F. Poole Agricultural Center (commonly called the P and A's Bulding). Overcrowding is a severe and prevailing problem.

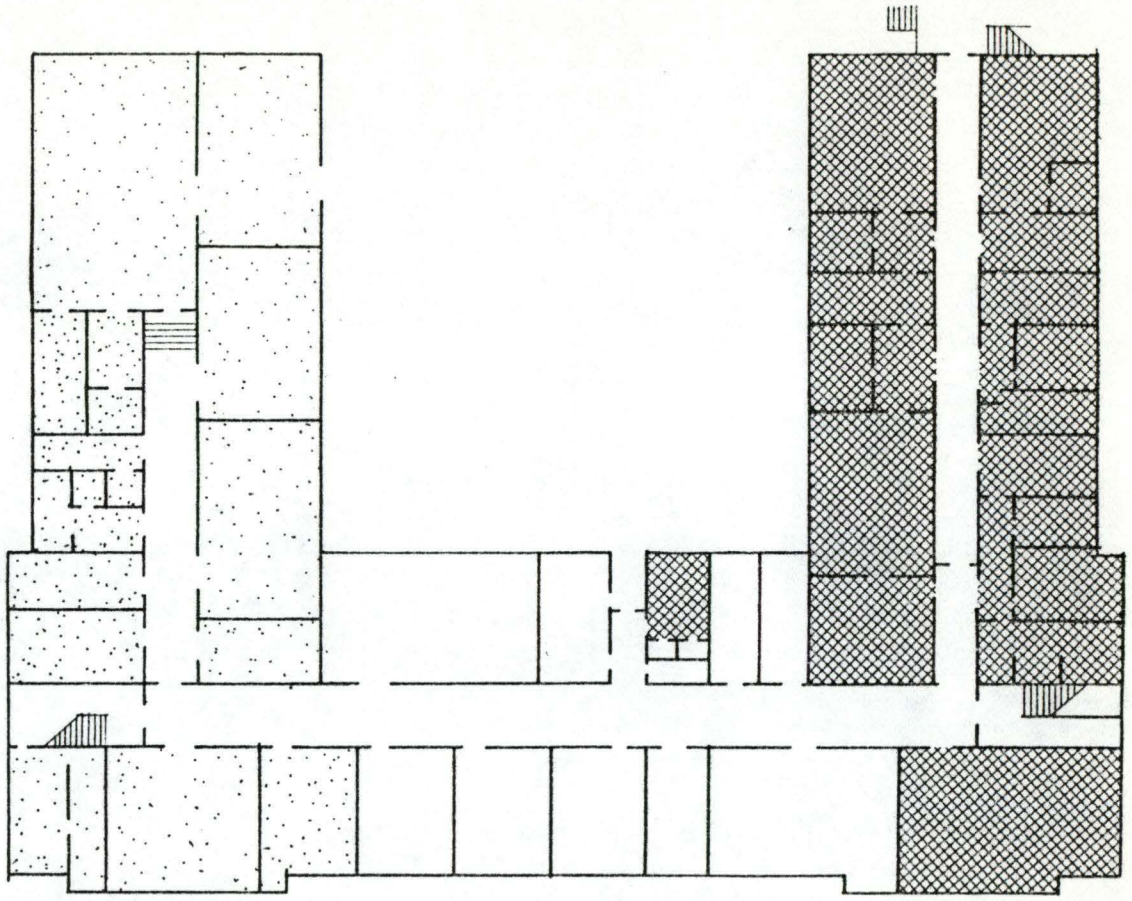
Offices, classrooms, and laboratories for the Department of Entomology, Wildlife and Fisheries are in Long Hall on campus, at two nearby insectaries and at the Wildlife Science Center overlooking Lake Hartwell. The department's facilities on-campus are generally focused on Entomology curricula. Along with unifying the department with its College, its removal from Long Hall will alleviate the need to construct a new College of Sciences. The realm of Entomology encompasses areas such as insect ecology, insect pathology, insect physiology, medical and veterinary entomology, pest management, taxonomy, and morphology.

The science and art of cultivating flowers, fruits, vegetables, and ornamental plants is the study of the Department of Horticulture. This includes not only the study of the economic product prior to harvest, but also in handling, processing, storage, and marketing. Current performance efficiency has distressfully decreased due to inadequate space in the R.F. Poole Agricultural Center. The Department of Horticulture's (along with Agronomy and Soils) vacated facilities is greatly needed by the remaining departments of food and animal science.

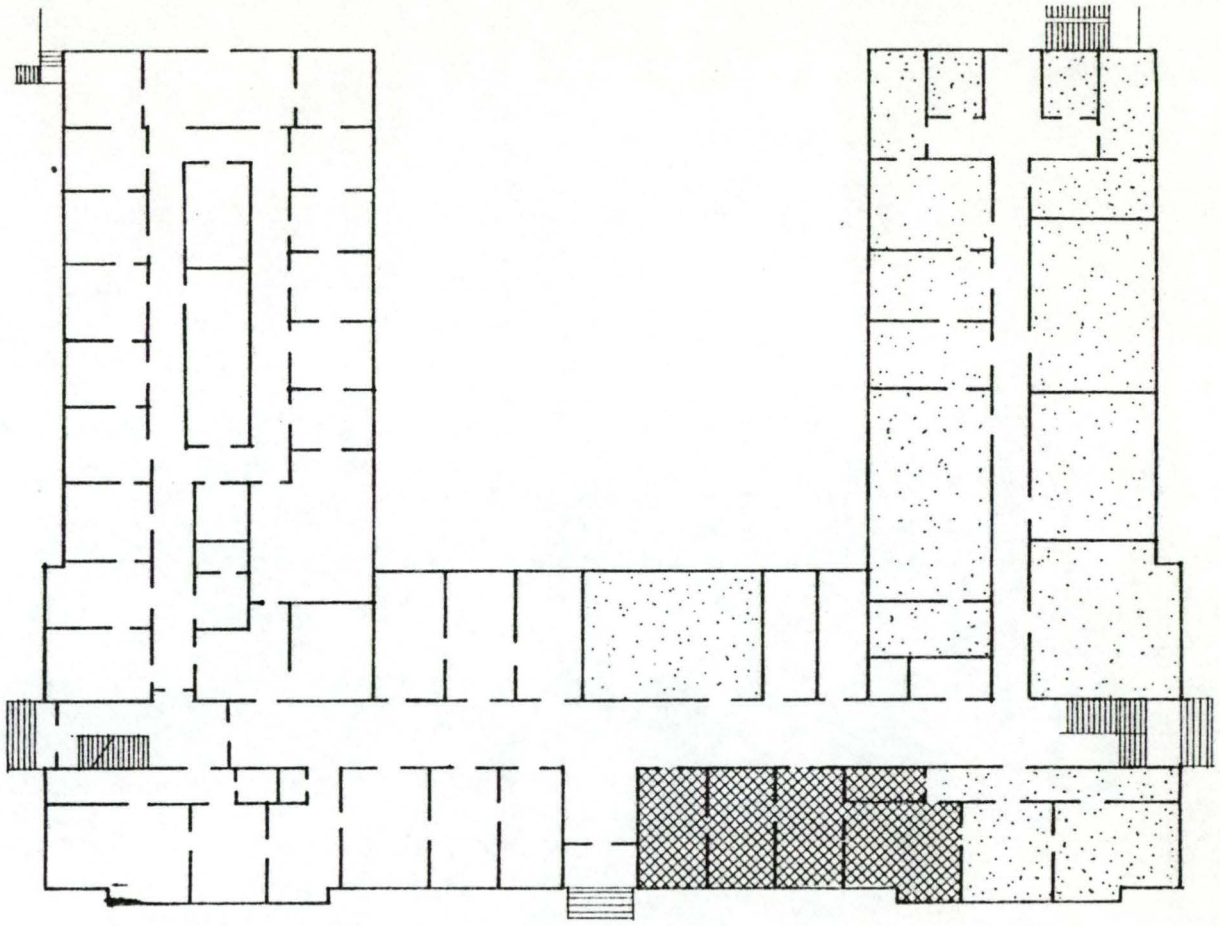
The physical situation of the Department of Plant Pathology and Physiology in Long Hall is of a similar state to that of the Department of Entomology, Wildlife, and Fisheries. Existing space is inadequate and expansion cannot be realized. Plant problem diagnostic work, along with research involving casual agents and host-pathogen interactions is the core of the Department of Plant Pathology and Physiology.



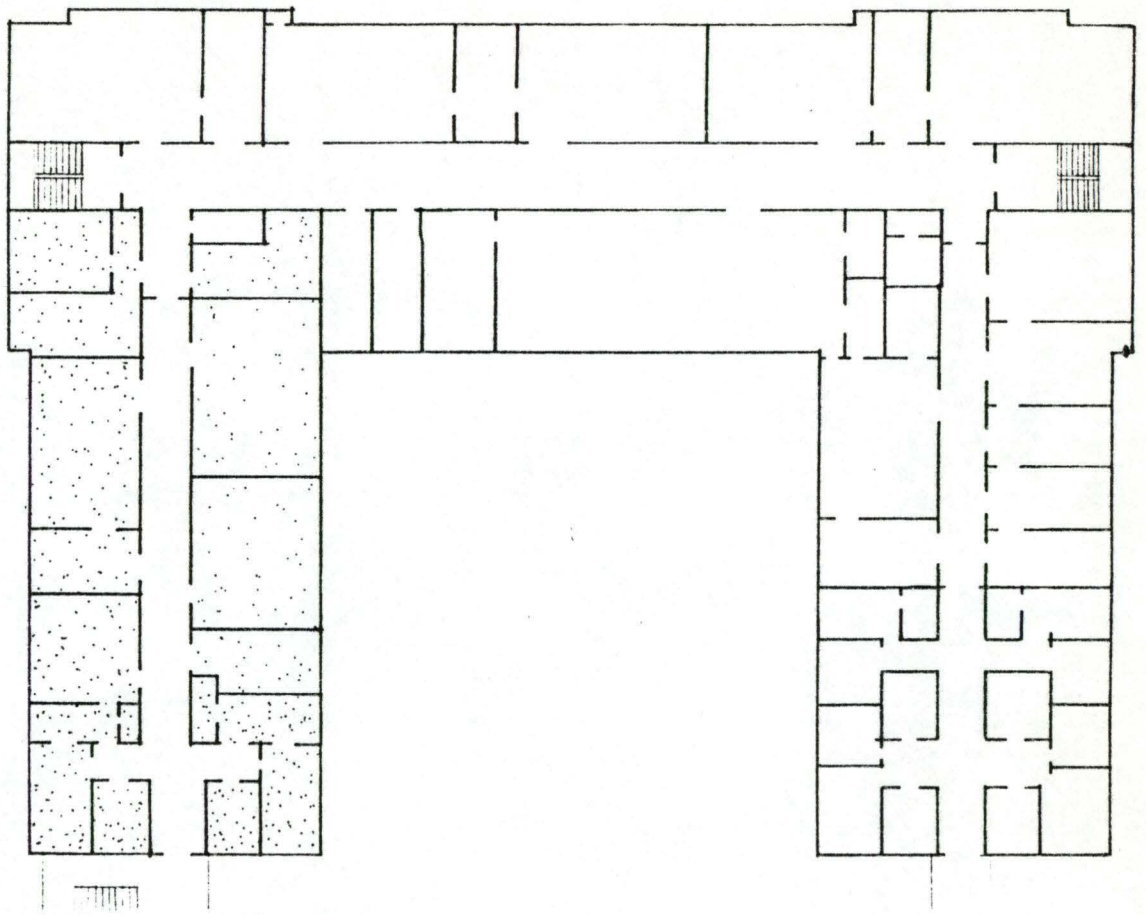
DEPARTMENTAL LOCATIONS



Long Hall Basement



Long Hall Ground Floor

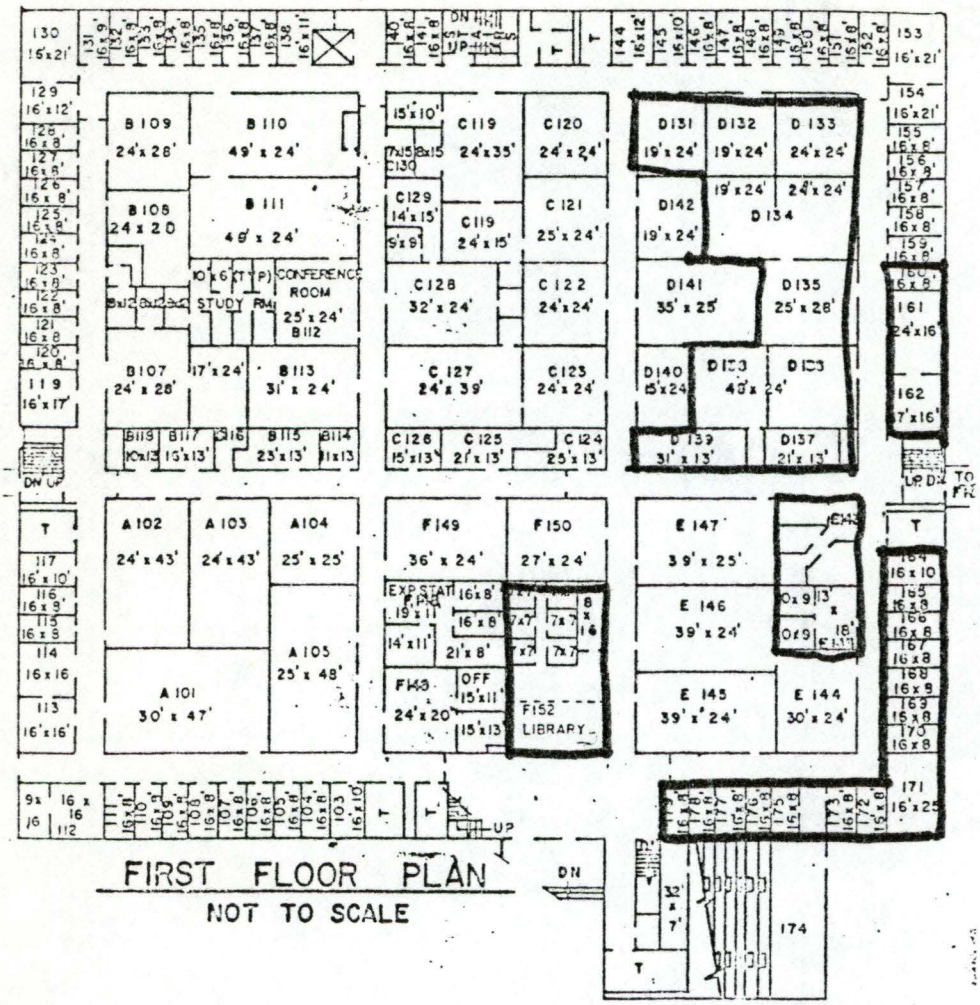


Long Hall Third FLoor

PLANT & ANIMAL SCIENCE

Atlas Sheet No.C-6

BLDG No. 0040



FIRST FLOOR PLAN

NOT TO SCALE

AREA

FLOOR SPACE 66,000 SQ. FT.

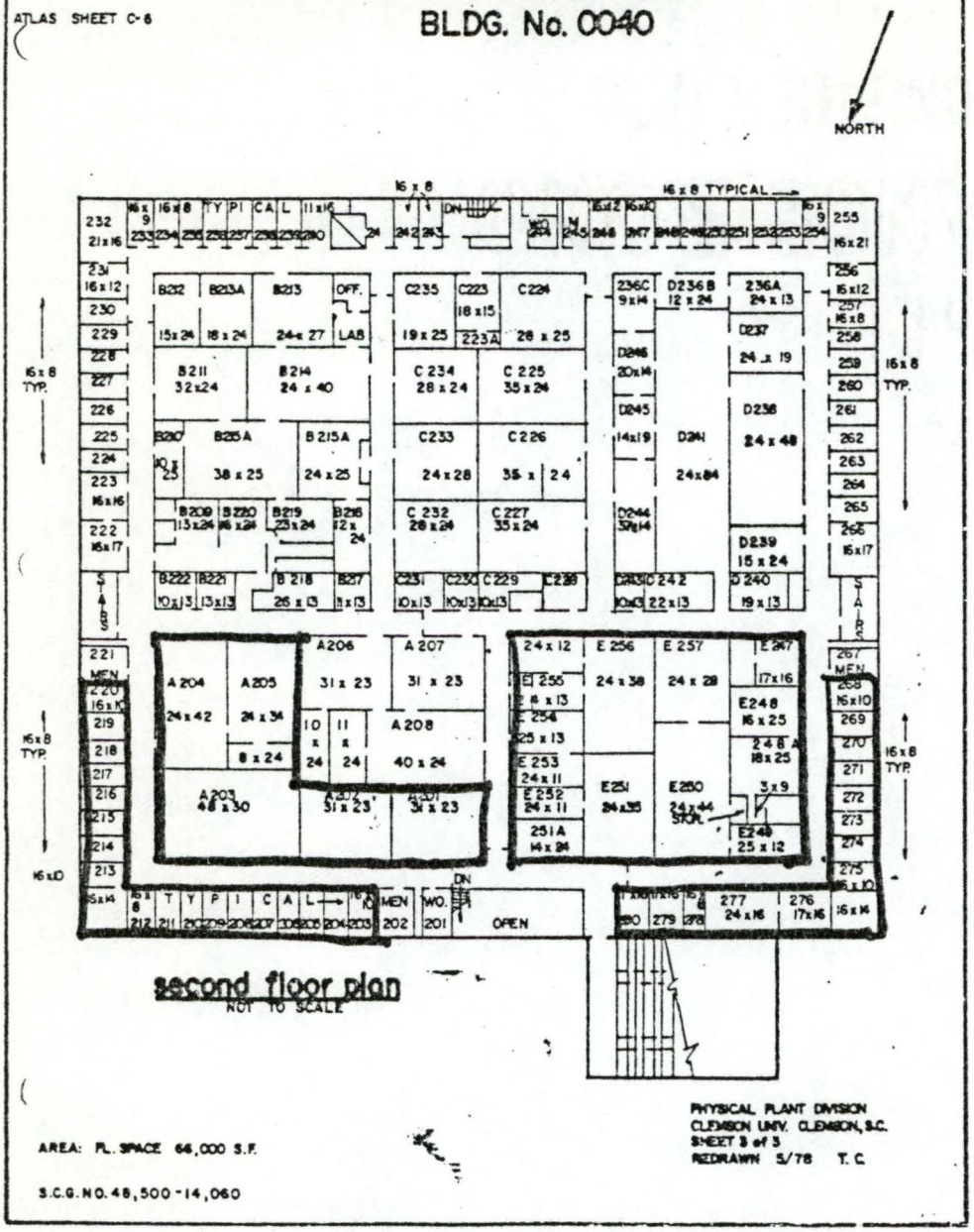
S.C.G.NO. 43,500-14,060

PHYSICAL PLANT DIVISION
CLEMSON UNIVERSITY - CLEMSON, S C
SHEET: 2 OF 3 DATE: 9-20-77 MES

PLANT AND ANIMAL SCIENCE

ATLAS SHEET C-6

BLDG. No. 0040



second floor plan

NOT TO SCALE

AREA: FL. SPACE 64,000 S.F.

S.C.G. NO. 48,500-14,060

PHYSICAL PLANT DIVISION
CLEMSON UNIV. CLEMSON, S.C.
SHEET 3 of 3
REDRAWN 5/78 T. C.

THE ACTIVITIES

A SURVEY

The primary purpose of the Plant Science Building will be that of a research facility for graduate students and faculty. It will also serve as an instructional facility.

This chapter is divided into four sections; offices, teaching laboratories, research laboratories and support facilities. The characteristics of the spaces required by the four Plant Science departments are similar enough to agree with this means of discussion. Where there are discrepancies they will be noted.

PERSONNEL

Administration

The entire administration area, plus conference room and reading room, should be located in a unit near the main entrance of the building.

The offices, work room (mail and catalog room), and the store room (file and store room) should comprise a single suite of rooms. This will contain the department head, department secretary, bookkeeper, and three typists. Each of the staff should have a private work area within this suite.

The conference room should be adjacent to the department head's office, but, accessible for general use.

Faculty

There are two categories of faculty members; the teacher/researcher and the researcher/extension agent.

The teacher/researcher requires a space consisting of an office in proximity to a research laboratory. This laboratory could comprise a unit with a work room and laboratory storage.

The researcher/extension agent needs an office space containing a rapid fix lab (sink, gas and water outlets). Storage room is required for visual aids, brochures, etc. The researcher/extension agent's office should be near the entrance but also, have access to the research laboratories.

Staff

The term Staff is a term that applies to faculty who are not physically located on campus but require a space while conducting business on campus. Their offices can be located near those of research and extension faculty.

Graduate Students

Carrel-type housing will be used within rooms for not more than 10 students but not less than 5 students. These spaces should be near faculty offices and accessible to research and teaching laboratories.

Technicians

Technicians supervise work done in the support areas such as the incubator room, autoclave, dishwashing, media prep, sterile culture/transfer, instrument room, etc. They require an area for a desk in these rooms or directly adjacent to.

Reading Room

The Reading room is an area designed for student, faculty, and staff use. Ample bookcases for resource material and a comfortable seating areas are needed.

It may prove advantageous to locate this room near the student lounge and administrative area.

PERSONNEL

	DEPARTMENTS			
	Agronomy & Soils	Entomology, Wildlife, & Fisheries	Horticulture	Plant Pathology & Physiology
Research – Teaching	17	22	19	11
Research – Extension	12	15	9	4
Graduate Students	35	66	25	15
Staff	8	15	9	8

INSTRUCTION

The classrooms should be near the entrance and adjacent to the administrative area. Although they should be near the teaching laboratories, they should not conflict with any work done near the research laboratories. All classrooms require student desks with a writing surface. An instructor's desk, usually 36" x 96" x 36", is equipped with a sink, water and gas, light controls, and room for a projector.

One auditorium is required to service all four departments. It should fulfill the above mentioned requirements.

Each teaching laboratory is designed to accommodate 20 students. Standard student desks are 24" x 144" x 30". This area will satisfy the needs of two teams of two students. Each team student station should have double electrical outlets, double gas outlets, 1-2 drawers, and a microscope cabinet. A large counter in the rear of the room would also have gas and electrical outlets. Fume hoods are necessary. A class sink should discharge hot, cold, and distilled water. An instructor's desk should be similar to that of a classroom's. A large storage area should be adjacent to the laboratory.

The teaching laboratories should be located near the classrooms and away from the research facilities. In the case of the Department of Plant Pathology and the Department of Horticulture, it is necessary that a teaching greenhouse be contiguous to the teaching laboratories.

RESEARCH

Each research laboratory is served by one faculty member, 1-2 technicians, and graduate students (assigned). A unit consisting of the faculty member's office, work room, lab storage and laboratory is desirable.

Research areas should be remote from student traffic. The research laboratories should be clustered in groups around the service and support facilities. Although private work spaces are needed, a feeling of team effort should be achieved by the clustering.

All laboratories should be free from all internal building vibrations.

Room furnishings and equipment include: 60 L.F. of work benches, 1 refrigerator, glassware drying rack, a minimum of two sinks, chalkboard, fume hood (8' x 8'), gas, water, 110V, 220V, air, and vacuum hookups at intervals of 10' on the work surface. The room should be connected to a floor drain system.

SUPPORT

Greenhouse/Headhouse

The Greenhouse/Headhouses are for the use of graduate students and faculty in their research and for production of plant materials for courses. In general, the Department of Horticulture and the Department of Plant Pathology and Physiology are the major consumers of the greenhouse's function. These departments also need a teaching greenhouse accessible from the teaching laboratories.

Greenhouses are standardly purchased, they are placed on a concrete slab. Some of the spaces requirements are: steam heat, a cooling system, electrical outlets on overhead rails, a tree room, controlled temperatures, cold, hot, and distilled water, side and top ventilation, and incandescent lighting.

Headhouses are commonly located on the northern side of the greenhouses. Along with providing storage space for pots, soils, fertilizer, seeds, tools, and chemicals a headhouse contains equipment for autoclaving and steam treating the soil.

Each greenhouse/headhouse unit requires accessibility by delivery vehicles. In addition, provisions need to be made for isolating greenhouses from their headhouses and the main building when insect control by fumigation or spraying is in process.

Pesticide Storage Room

This space needs to be kept at a constant temperature and humidity. The ventilation system needs to be separate from that of the building.

General Lab Storage

Lab Storage is usually directly adjacent to the laboratories.

Autoclave, Dishwashing, Media Prep

All research laboratories need access to this room. The three functions carried on in this area are: autoclaving which requires an exhaust fan to the exterior of the building, also steam and water hookups, a dishwashing area with a commercial dishwasher, sink, drying racks, carts, and shelves, media prep needs gas, air and vacuum, a 14' long bench with cabinets above.

Sterile Culture/Transfer Room

This room must have the ability to be totally steam sterilized. Other necessary characteristics are: ultraviolet lighting, air conditioning with positive air pressure, steam, gas, vacuum, water, and a work space.

Instrument Room

This space requires shelves for instruments which should be available to all of the laboratories.

Isotope Work Room

A six foot fume hood should ventilate fumes to the exterior of the facility. Along with a work surface, gas, air, vacuum, and water are needed.

Shipping and Receiving Room

This area should be located near the administration, but also be centralized enough to deliver some of the heavy supplies to every location in the facility.

Plant and Soil Sample Work Room

Usually situated in the basement, this space requires 2-3 sinks, vacuum, air, gas, and distilled water.

Growth Chamber Room

A humidity controlled situation of 50% ± 5% and a variable temperature control are necessary for this environment. The room may be placed in the basement.

Cold Rooms

Accessibility to the laboratories is essential. A constant temperature of 35 degrees F. must be maintained.

SEM/TEM Room

This space is a suite of rooms, usually in the basement with a separate foundation to eliminate vibrations.

1. SEM room--incandescent and fluorescent light (variable), chilled water source
2. TEM room--(same as above)

3. Dark room--photographic safe lighting, sink work space
4. Sectioning room--gas, hot, cold, and distilled water, vacuum and a work bench
5. Preparation Lab--(same as above)

Insect Rearing Room

This space needs a separate ventilation system with hook-ups for gas, water, vacuum and air.

Dark Room

This room has all the aforementioned requirements of a dark room but should be located conveniently to the research laboratories.

Incubator Rooms

This room should be located near the laboratories. It requires plenty of electrical outlets for the incubators.

CASE STUDIES

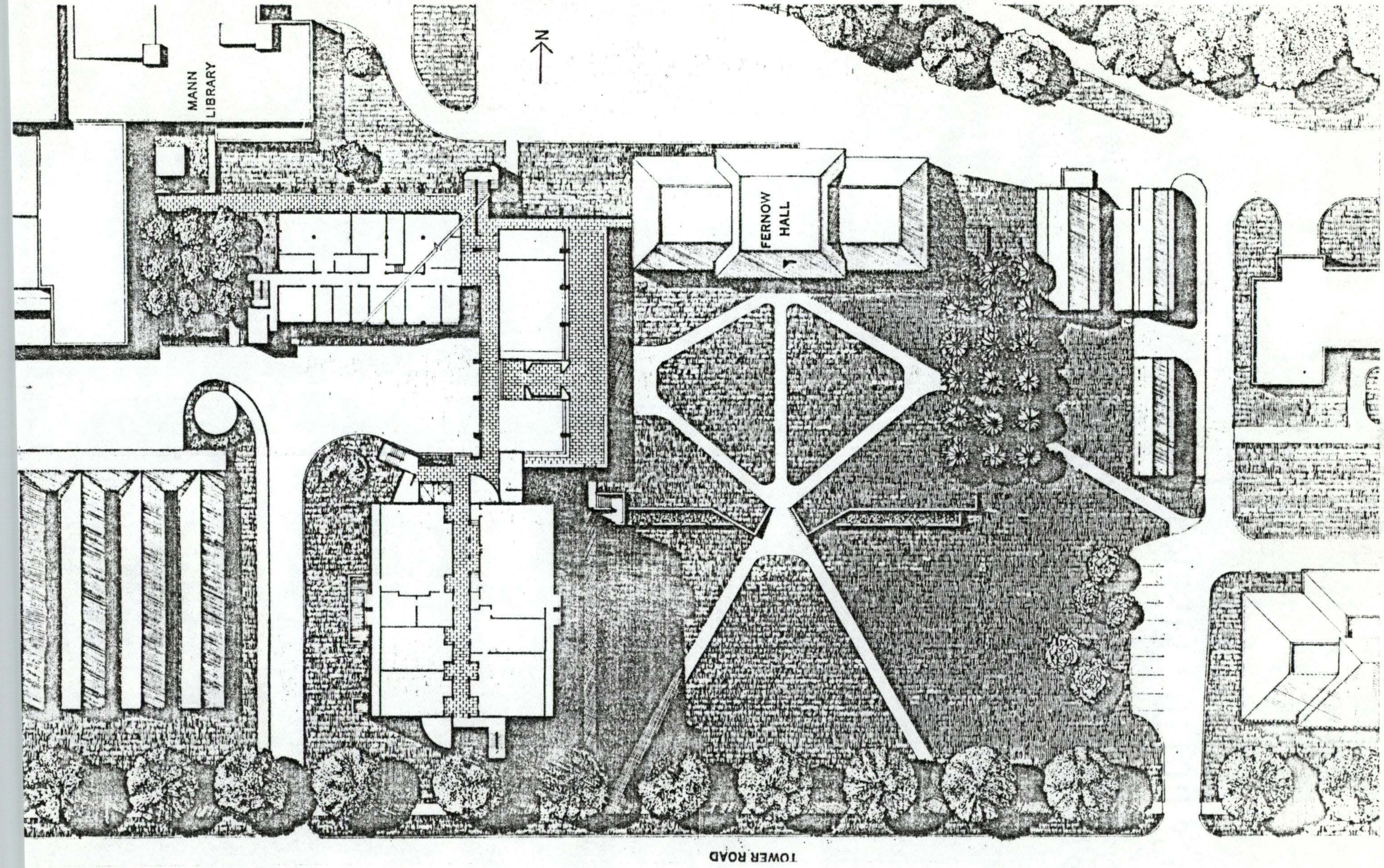
AGRONOMY BLDG.

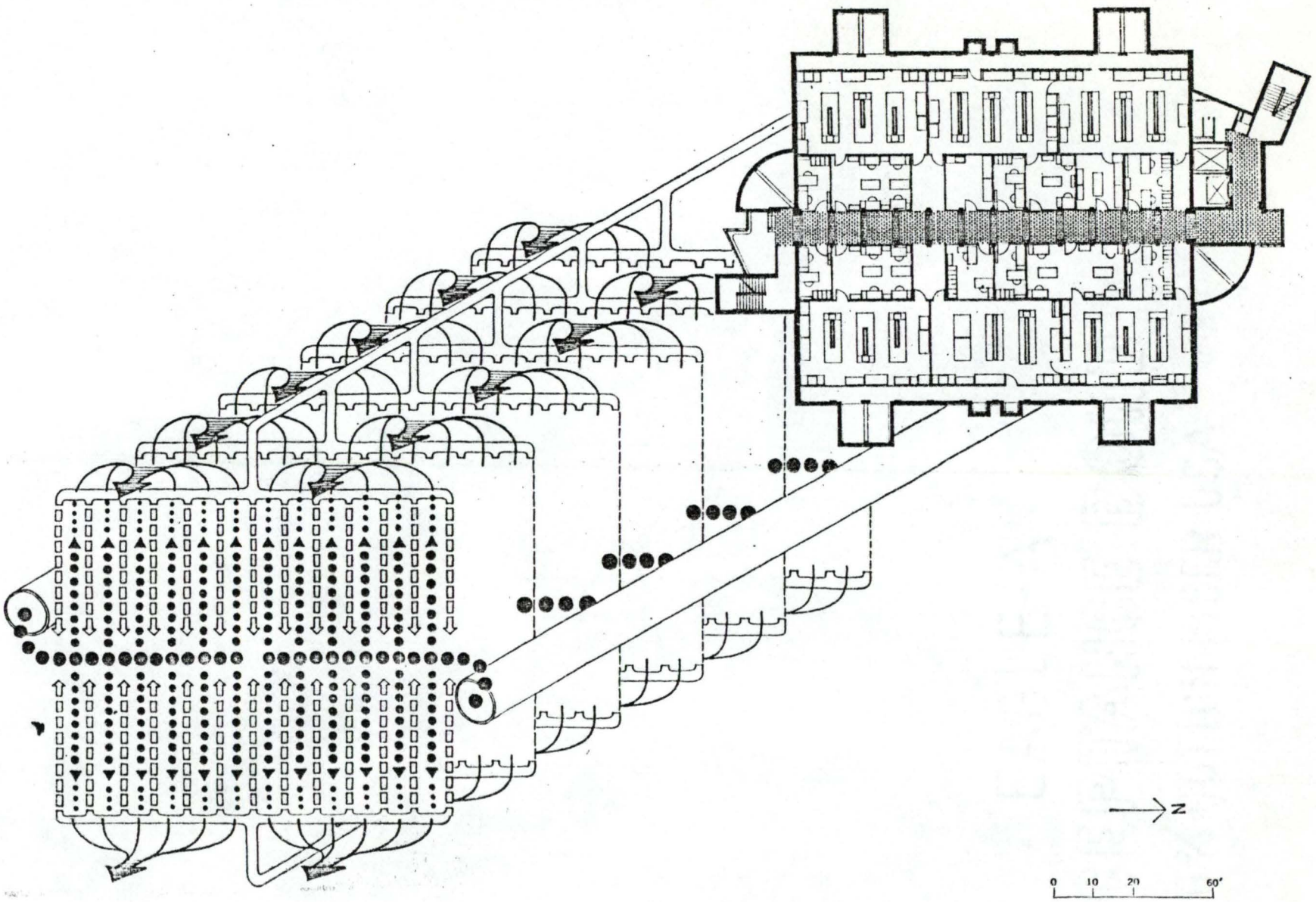
The New York State College of Agriculture in Cornell occupies what is known as the "upper" campus; Cornell University occupies what is known as the "lower" campus. The Agronomy Building creates an assertive and important presence to an "upper" campus area which had previously not been expressed in its uniformly low and modest institutional buildings. The vertical brick masses punctuate a border of existing academic buildings, all within the College of Agriculture. Ulrich Franzen has separated the research labs and offices into two distinct wings--a multi-faceted, windowless thirteen story tower housing research labs; and adjoining, glazed two story wing for administration.

The tower and turrets of what appears to be a medieval brick fortress are in reality shafts for functional systems. Two of the shafts serve the heating, ventilating and air-conditioning system with fresh air drawn in at the ground level. This air remains uncontaminated by the foul air which is discharged skyward by two great snorkels, each side of the building. Two shafts at the north and south ends are stair towers, and the widest of what appears to be rather flat buttresses on the east and west facades contain chases for plumbing and electrical risers. The

other narrow vertical elements are masonry piers that grow in area as the load collects toward the ground. Concrete tee beams tie into the piers at the various floor levels. Franzen refers to the window bays at the end of the central corridor on each floor as oriels.

Ulrich Franzen has carefully articulated both "served" and "servant" spaces. Each research floor is organized around a central corridor. Research spaces, planned around an 8-foot, 6-inch laboratory services distribution module, extend 36 feet on either side of the central corridor to a 4-foot mechanical distribution alley at the east and west perimeter of the research facility. Offices and workrooms are introduced along the central corridor with labs on the outside wall. Laboratories can extend the entire depth, however, since services are available for 36 feet.


N
MANN LIBRARY
FERNOW HALL
TOWER ROAD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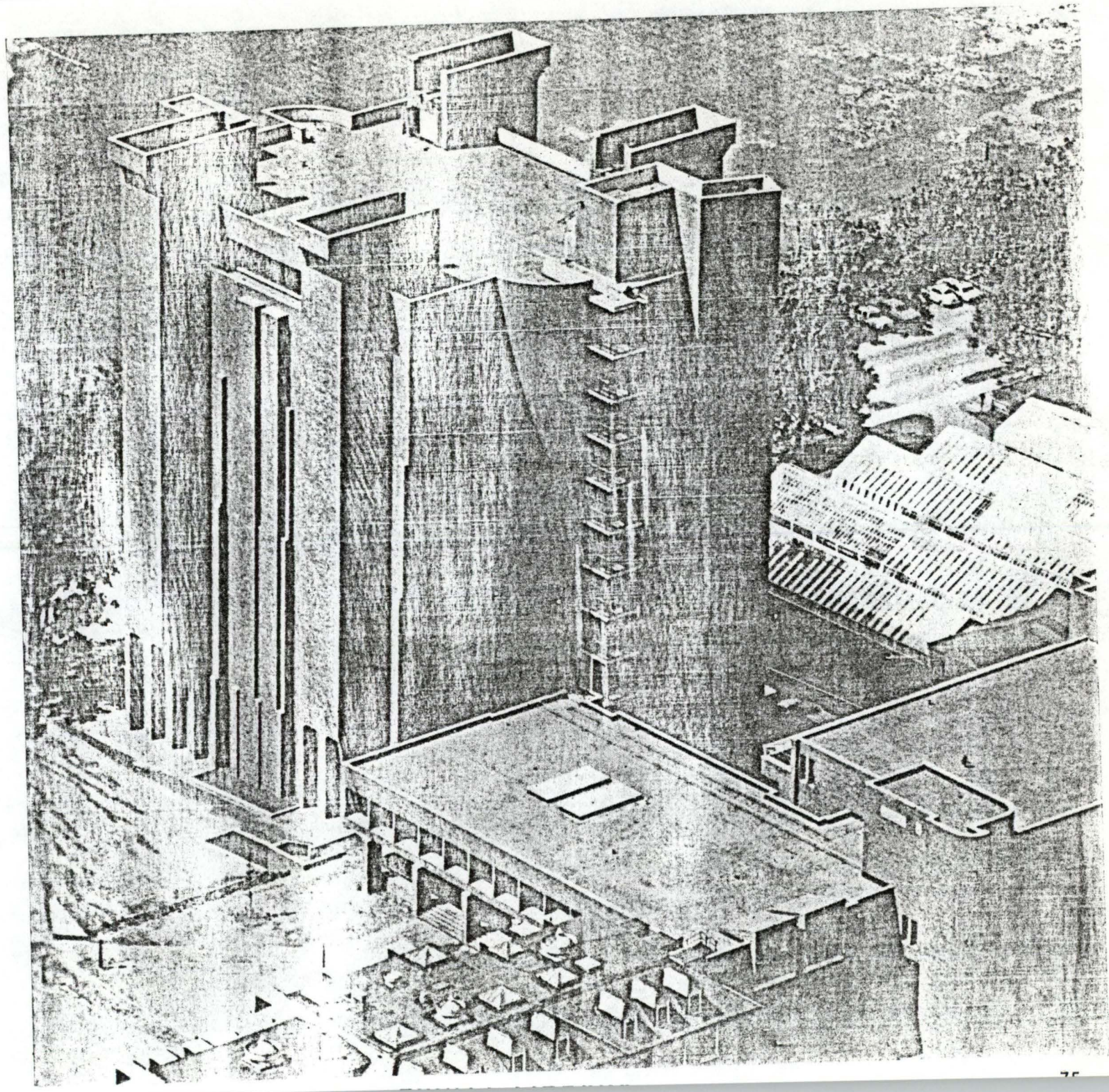
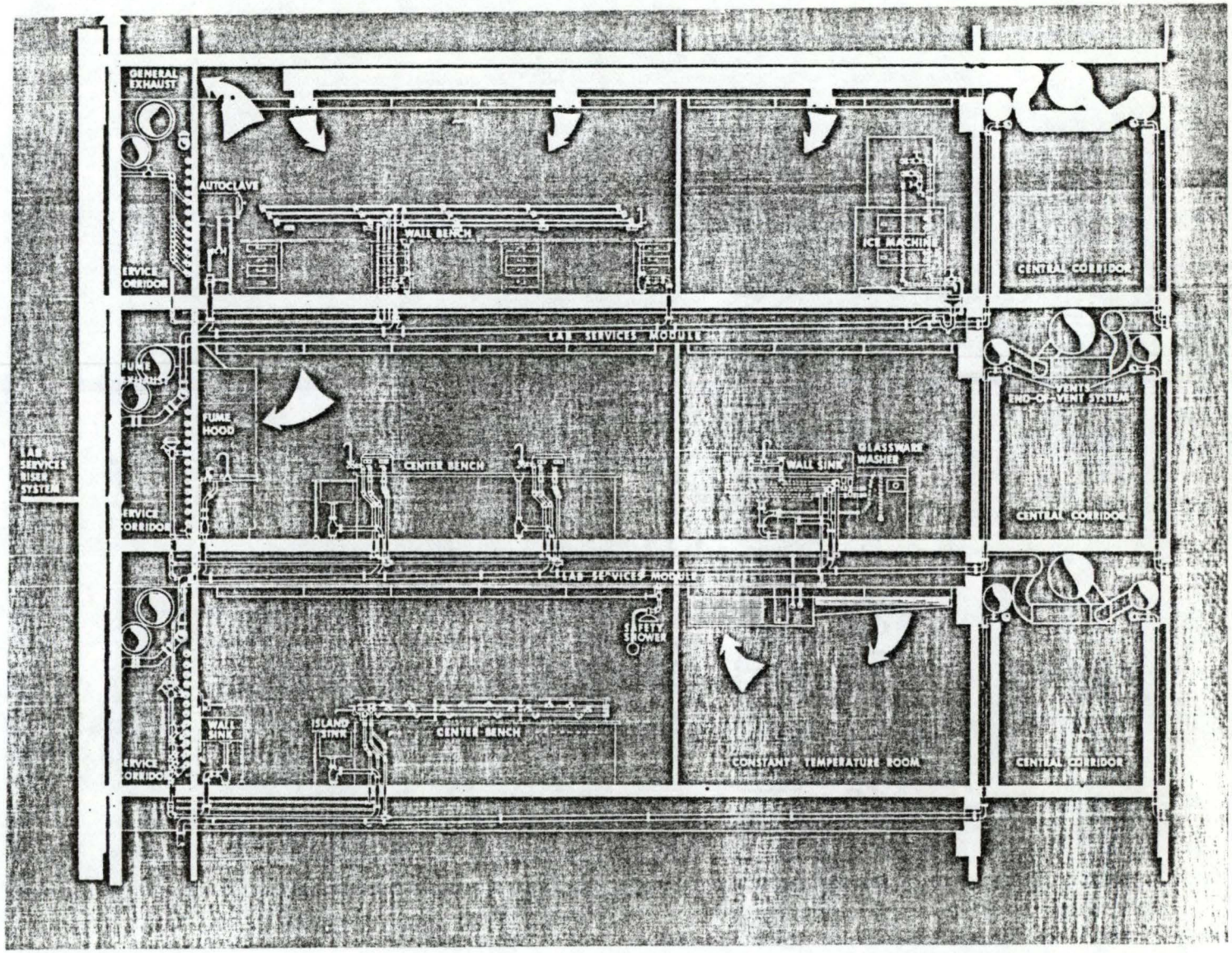
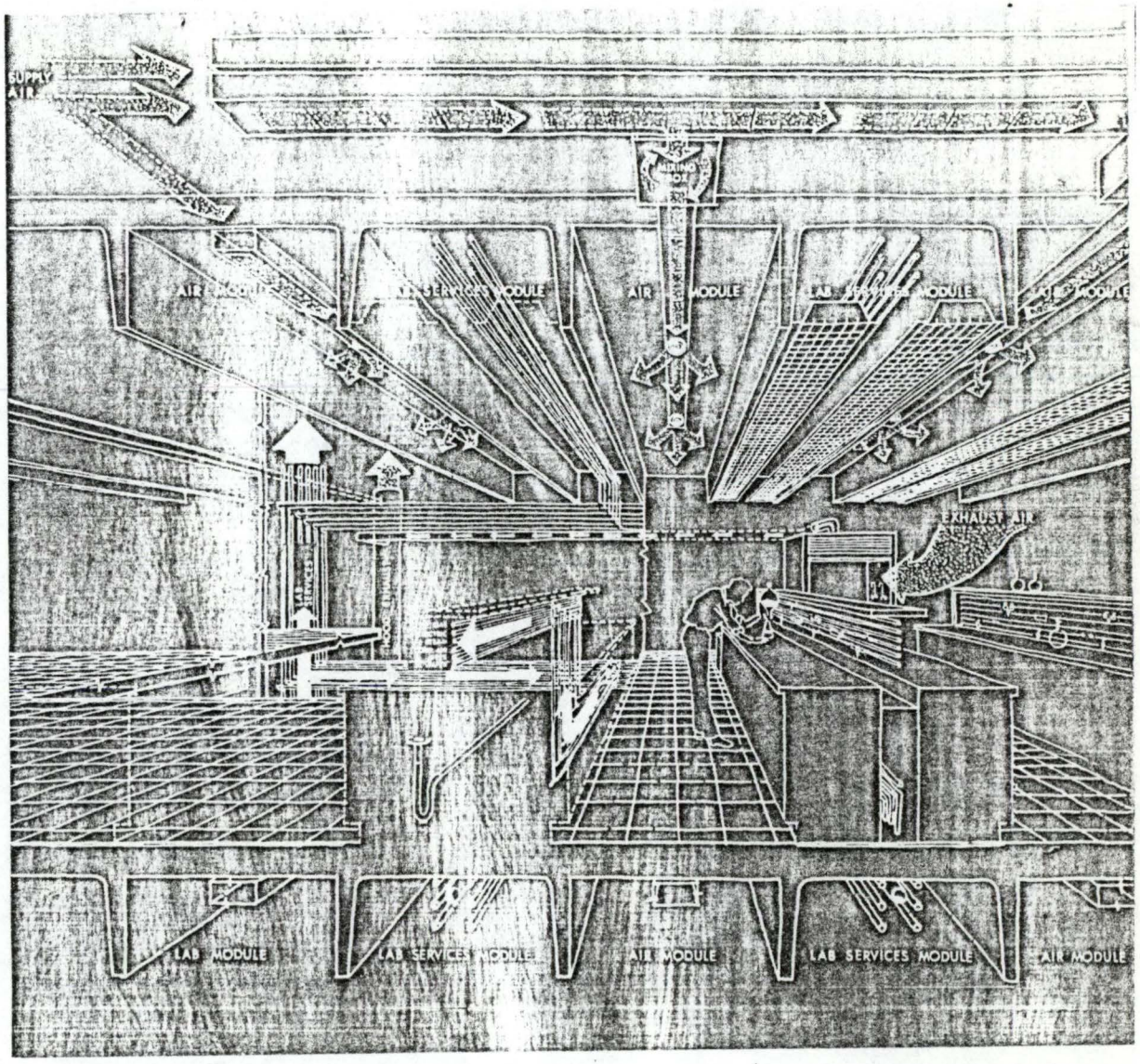
0 10 20 60'




GENERAL EXHAUST
AUTOCLAVE
WALL BENCH
ICE MACHINE
CENTRAL CORRIDOR
SERVICE CORRIDOR
LAB SERVICES MODULE
FUME HOOD
CENTER BENCH
WALL SINK
GLASSWARE WASHER
VENTS
END-OF-VENT SYSTEM
LAB SERVICES RISER SYSTEM
SERVICE CORRIDOR
LAB SERVICES MODULE
SAFETY SHOWER
WALL SINK
ISLAND SINK
CENTER BENCH
CONSTANT TEMPERATURE ROOM
CENTRAL CORRIDOR


SUPPLY AIR
MIXING BOX
AIR MODULE
LAB SERVICES MODULE
AIR MODULE
LAB SERVICES MODULE
EXHAUST AIR
LAB MODULE
LAB SERVICES MODULE
AIR MODULE
LAB SERVICES MODULE
AIR MODULE

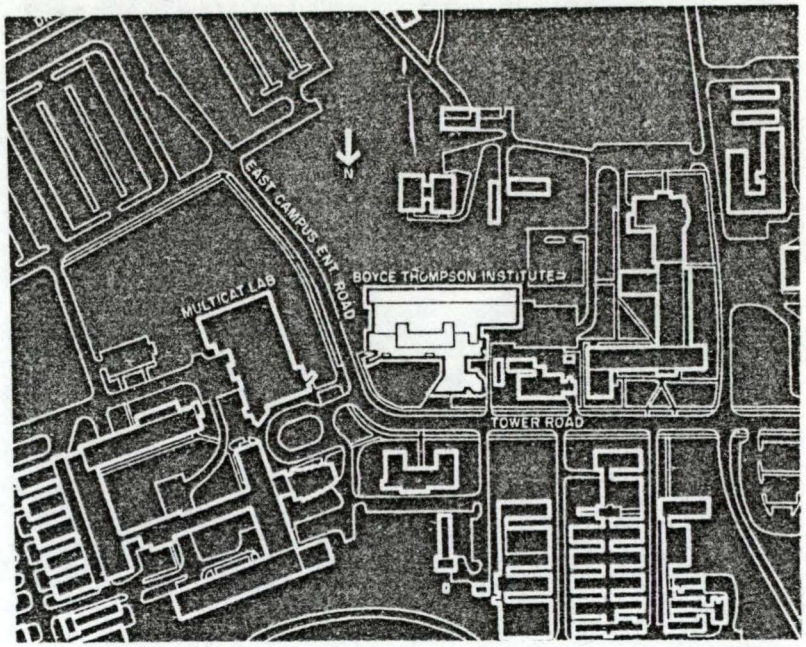
BOYCE THOMPSON INSTITUTE

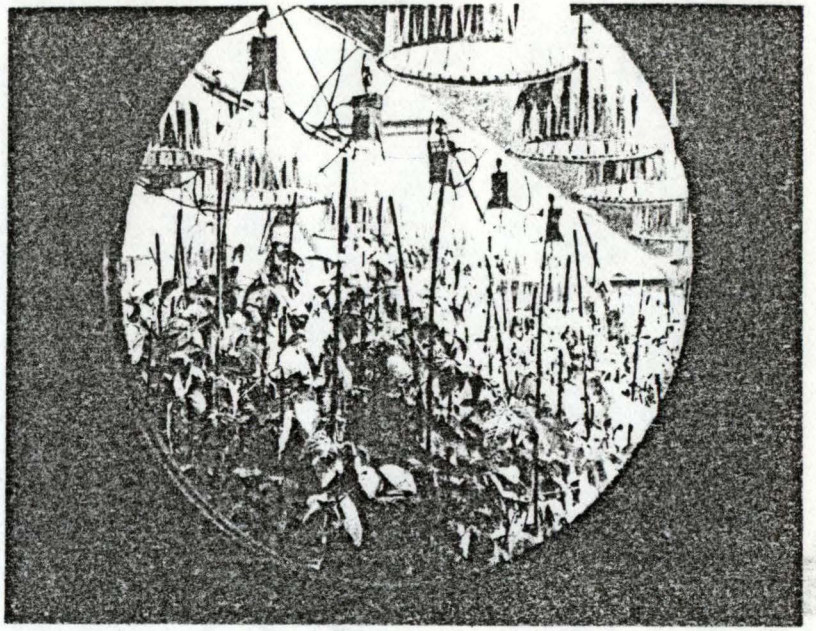
The Boyce Thompson Institute, a plant and physiological research center founded at the turn of the century, moved from an outdated facility to the Cornell campus in 1979. The institution provides an educational link to similar activities at Cornell along with acting as a visual terminus to the main campus artery, Tower Road. An angular entry scoop opens from a green space at the intersection of several science buildings into an unexpected plant-filled atrium. The northern side is designed at a human, people-related scale, while the southern elevation is designed as the "scientific" machine at a bold scale. This southern elevation is a dramatic juxaposition of a 400-foot long transparent glass greenhouse with the severe, windowless brick face of the brown brick building beyond. Correspondingly, the interior spaces are programmatically arranged, with public areas on the "office building" (north) elevation and research areas on the "machine" elevation. There is a progression from the community spaces--entrance, atrium, auditorium, library--to partially climate-controlled labs to full environment-controlled labs, potting rooms and greenhouses.

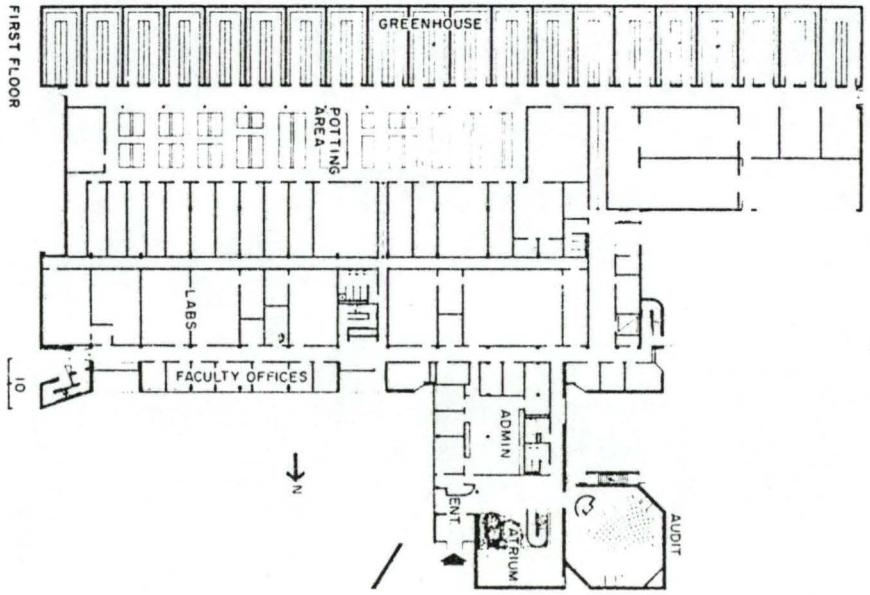
In reaction to the extraordinary volume of fresh air changes required for various activities it was worthwhile to retrieve some energy from the exhaust air

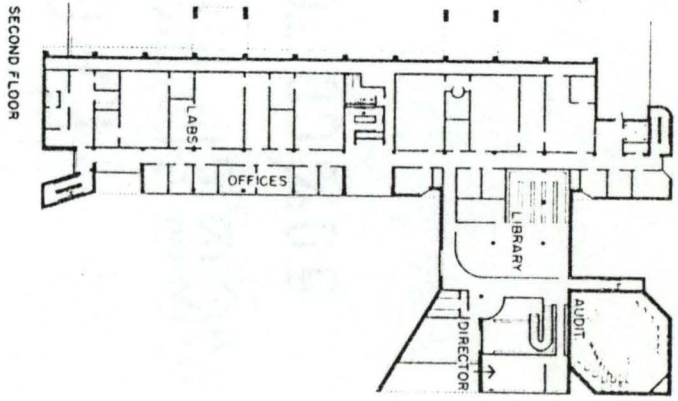
and transfer it to incoming fresh air by the use of heat recovery wheels. The tops of these wheels read as rounded protrusions on the south elevation. Horizontal blue reflectors at the cornice line act as deflectors of exhaust fumes from internal equipment.

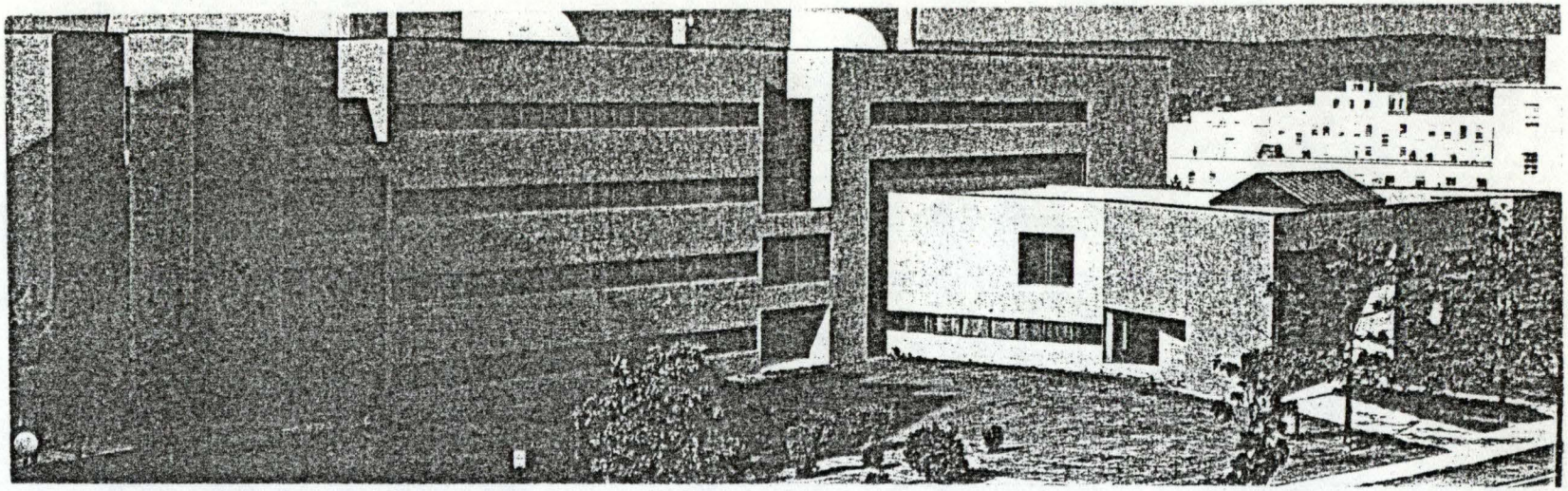
Ulrich Franzen states that "while the scientific inquiry is sustained by equipment, the architectural inquiry is in designing such scientific spaces to be as human as possible--balancing these two aspects of our lives."

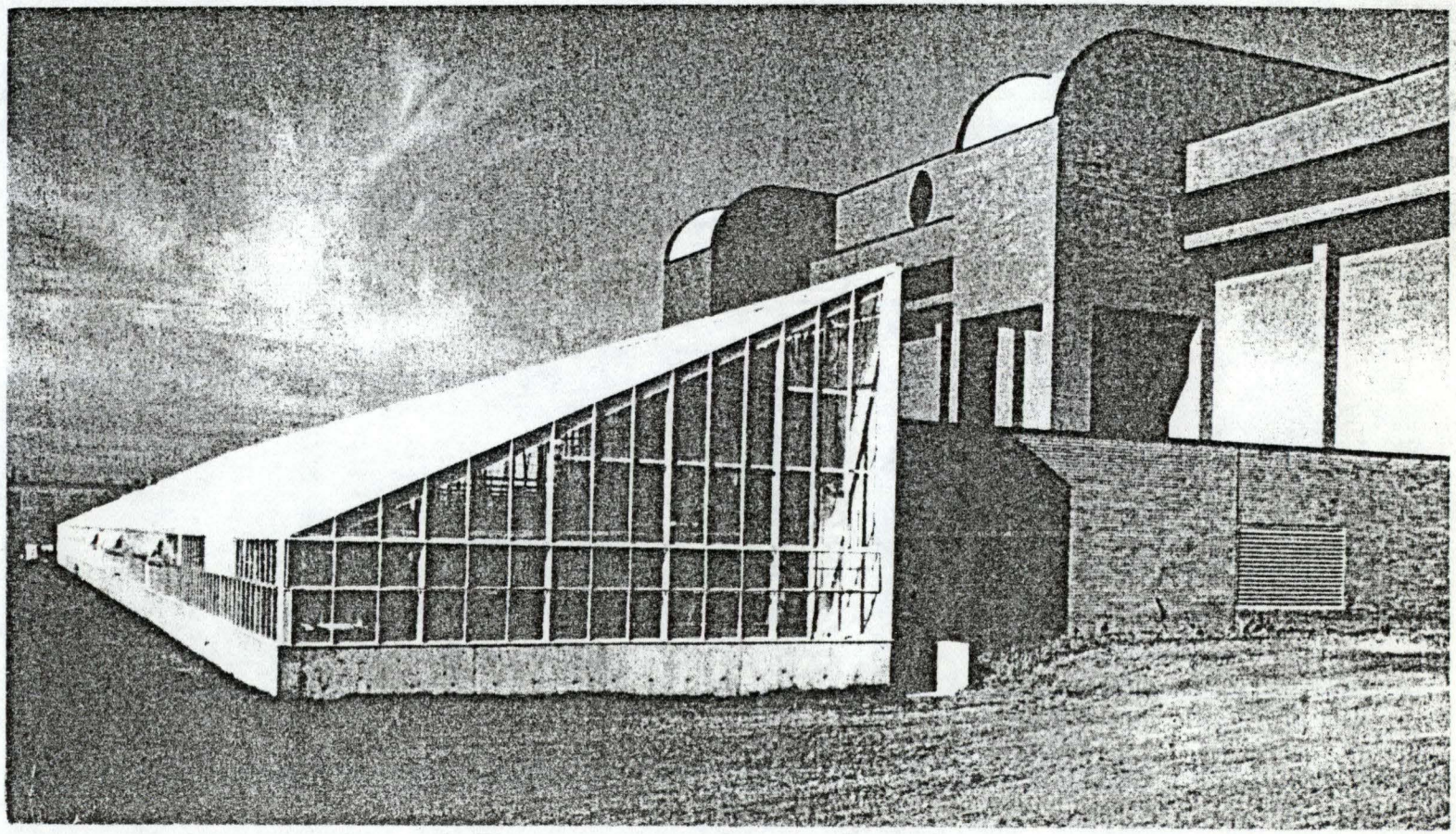

N
EAST CAMPUS ENT. ROAD
MULTICAT LAB
BOYCE THOMPSON INSTITUTE
TOWER ROAD

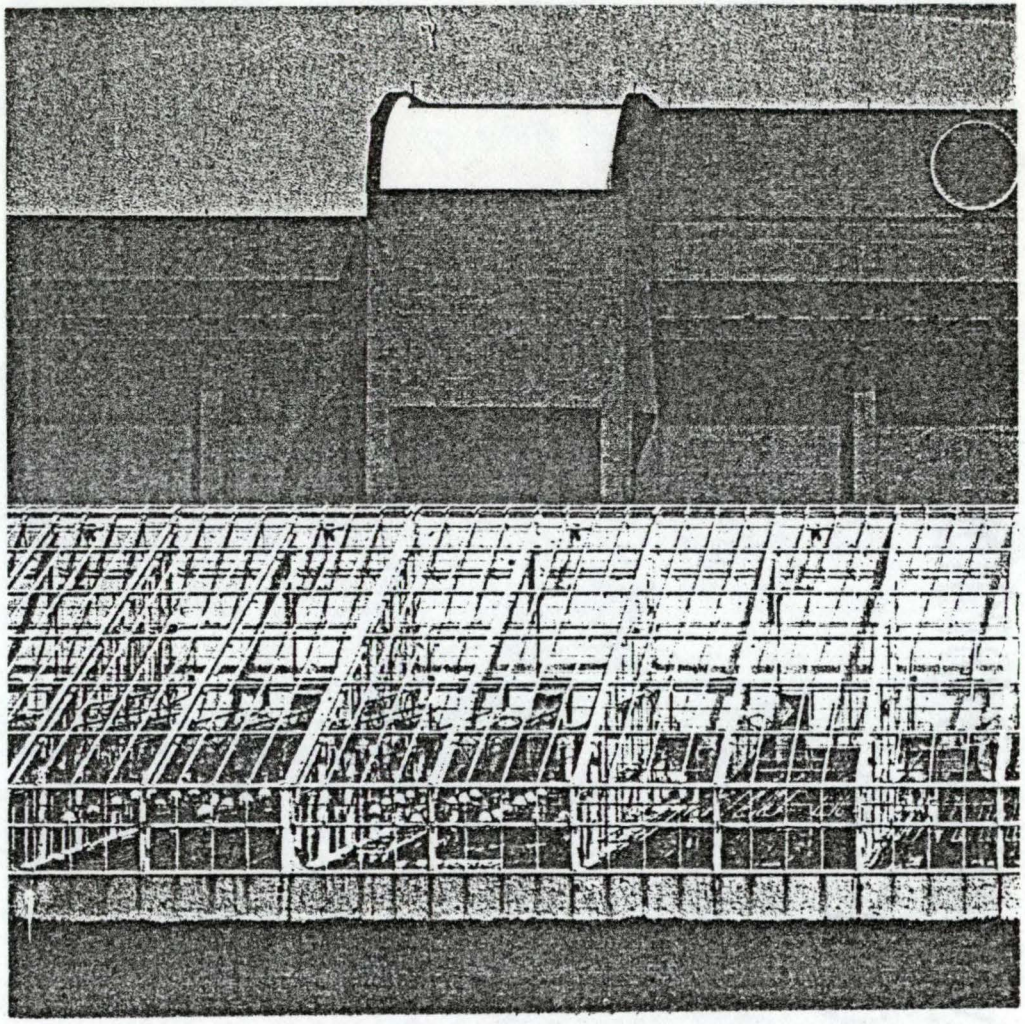


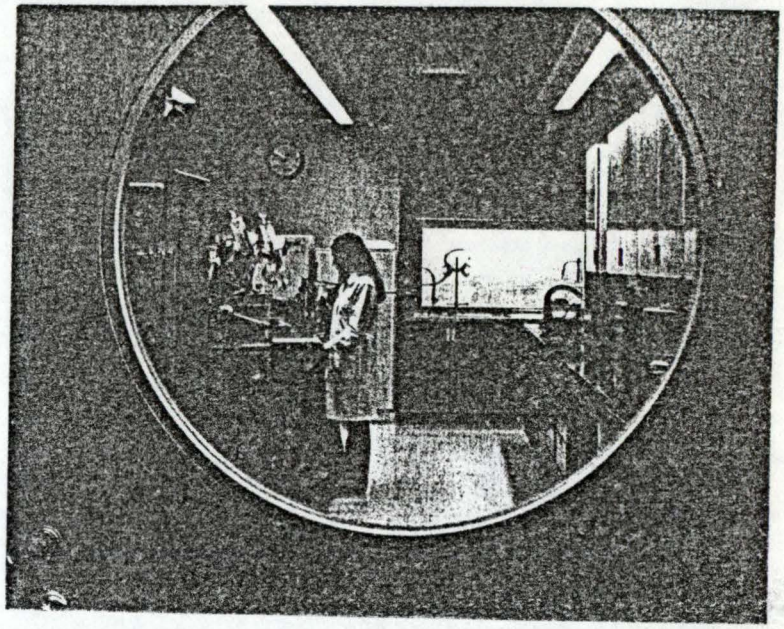

FIRST FLOOR
GREENHOUSE
POTTING AREA
LABS
FACULTY OFFICES
ADMIN
ENT.
ATRIUM
AUDIT
N

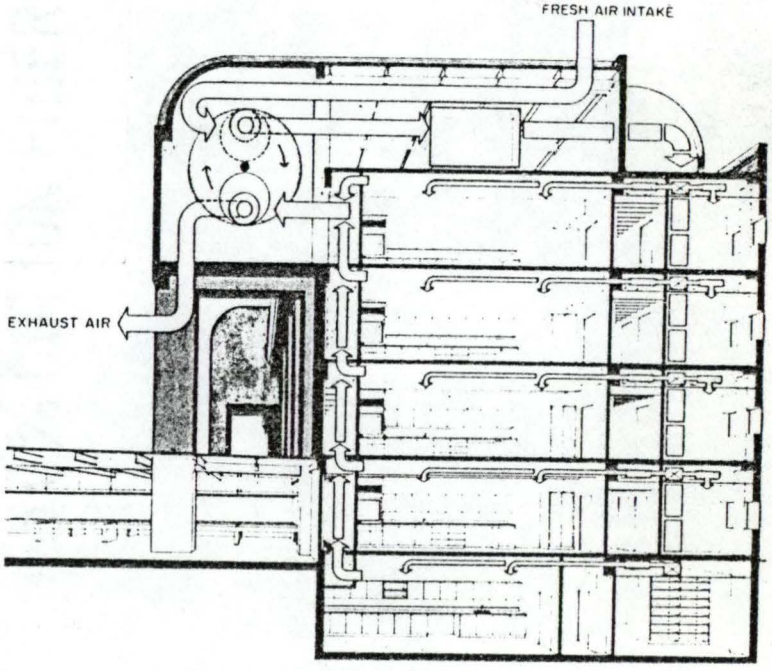

SECOND FLOOR
LABS
OFFICES
LIBRARY
DIRECTOR
AUDIT

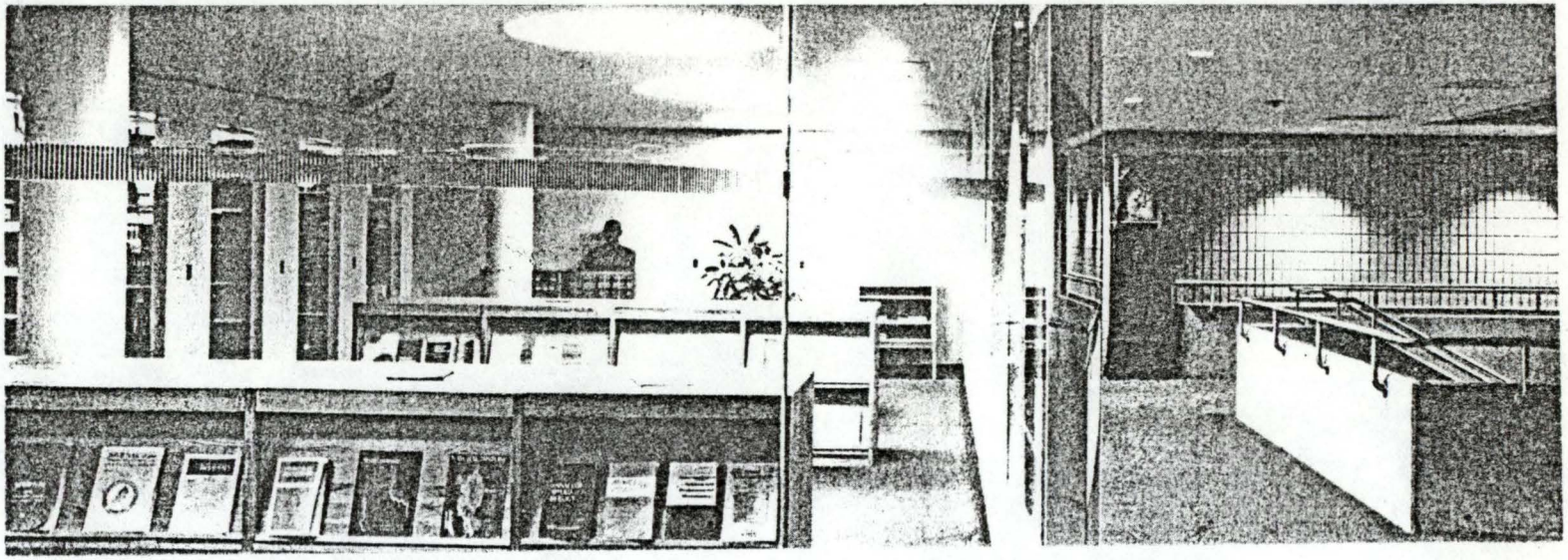


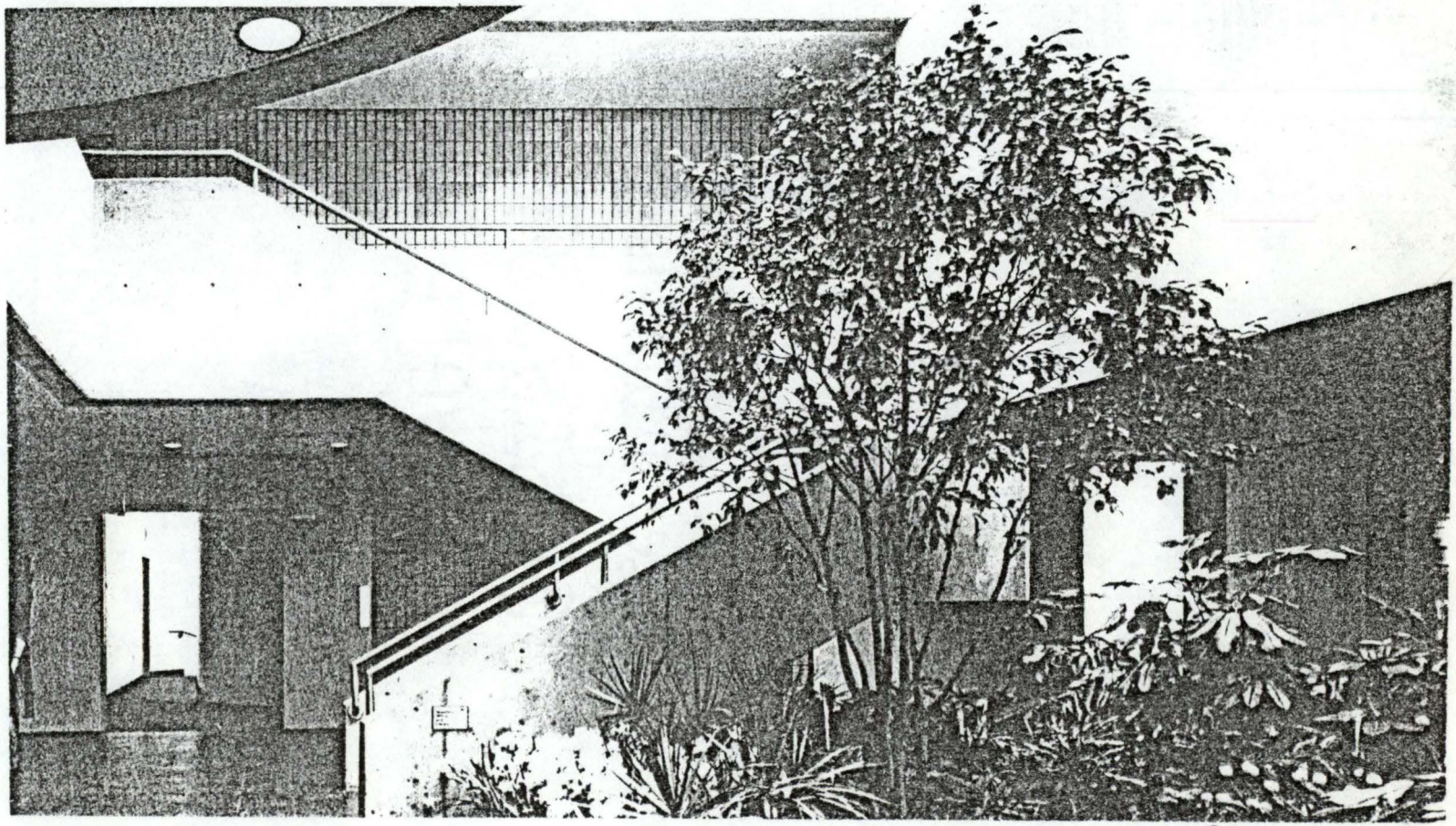







FRESH AIR INTAKE
EXHAUST AIR



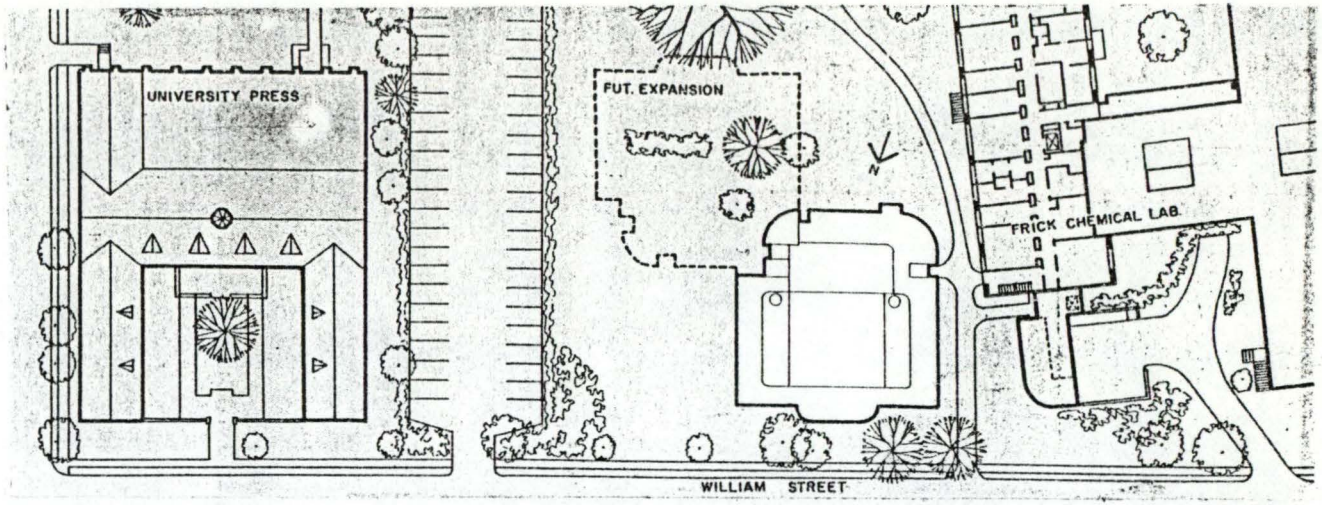


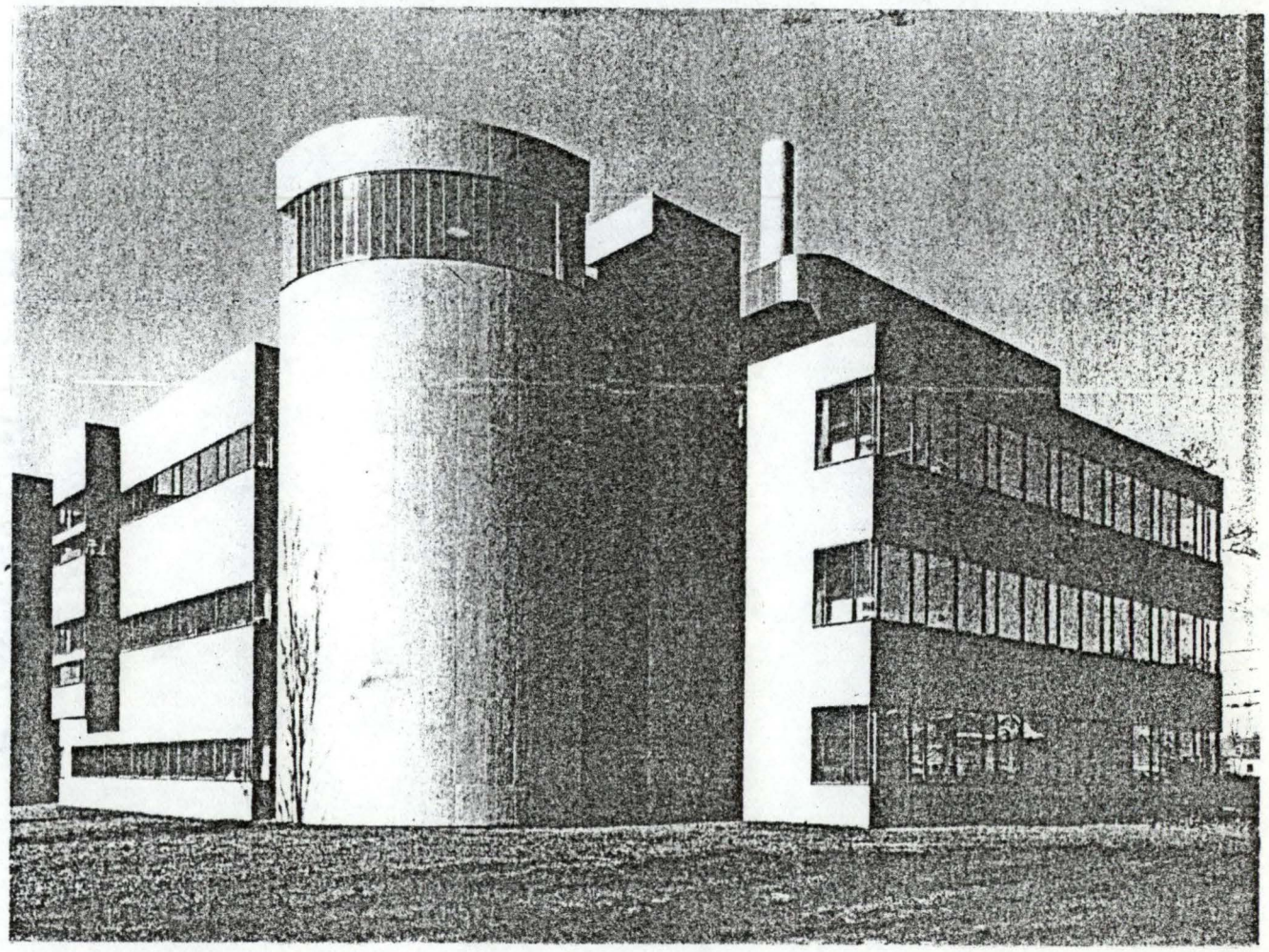
BIO-CHEM LABORATORIES

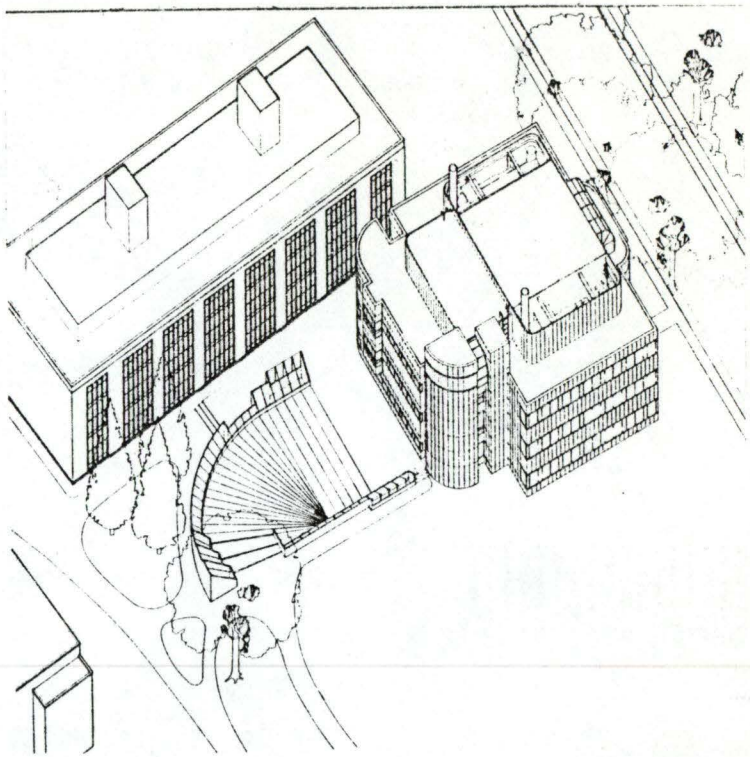
Along the eastern edge of campus, a collection of buildings of disparate style and age, the Biochemistry Science Laboratory creates its own dominant element. Each of the four elevations is different--responding logically to the interior functions and in response to energy conservation goals. The new building attempts to pick up the scale of its setting by retaining the cornice line of the adjacent Frick Chemistry Laboratory and the height of another adjacent building's roof. In addition, the new facility is clad in gray granite to bridge the variegated color of the stone in surrounding buildings. The actual building structure is concrete, designed to be vibration-free contained in the interior spaces.

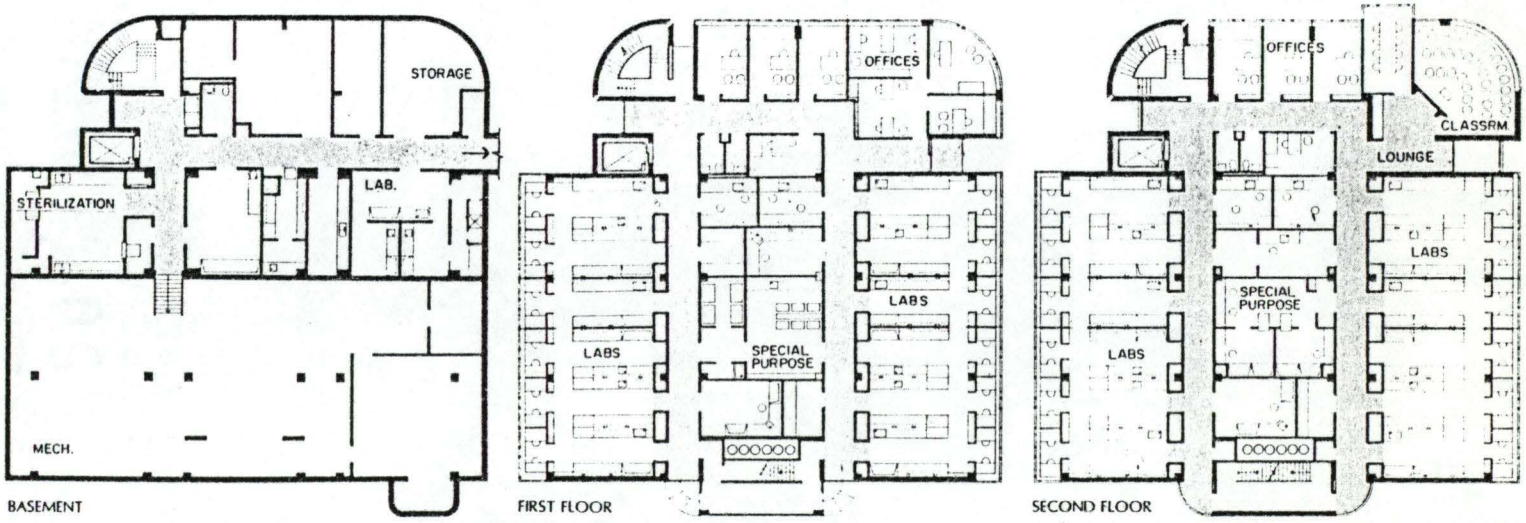
The new 38,000 square foot building acts as an extension of the Frick Chemistry Laboratory, its special function being highly technical biochemical (and particularly cancer) research. The precise number, area, and organization of the client's programmatic data were well defined and quite inflexible, leading Davis, Brody's scheme to be one of simplicity and logic. On each of the three laboratory floors, a single corridor wraps around a central core of specialized labs requiring specific provisions--in surface materials and in the air and liquid exhaust--to

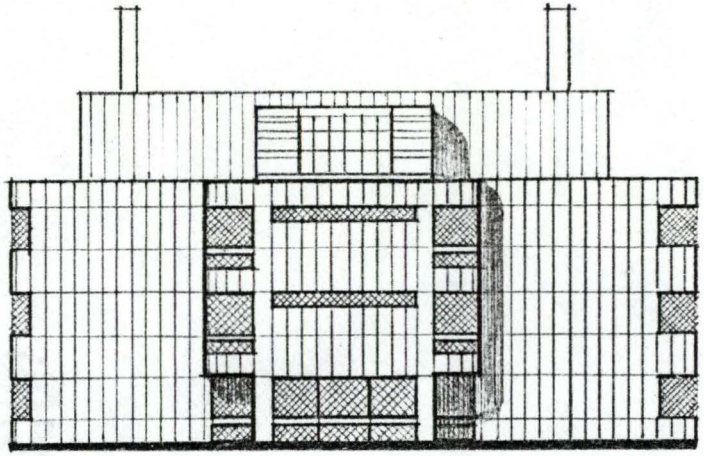
protect against contamination. On the east and west walls, the corridor opens to more conventional laboratory spaces, which can be subdivided on a ten foot module for research teams of various sizes. A system of open offices along the window wall provides desk space to researchers but does not block light from reaching into the laboratory spaces.


UNIVERSITY PRESS
FUT. EXPANSION
FRICK CHEMICAL LAB.
WILLIAM STREET

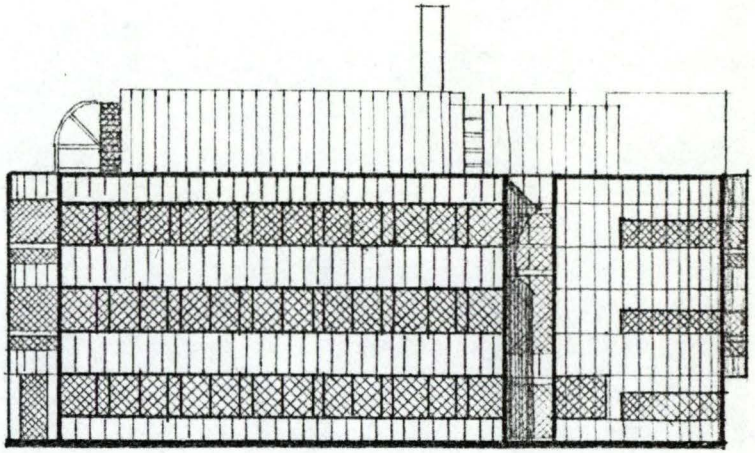




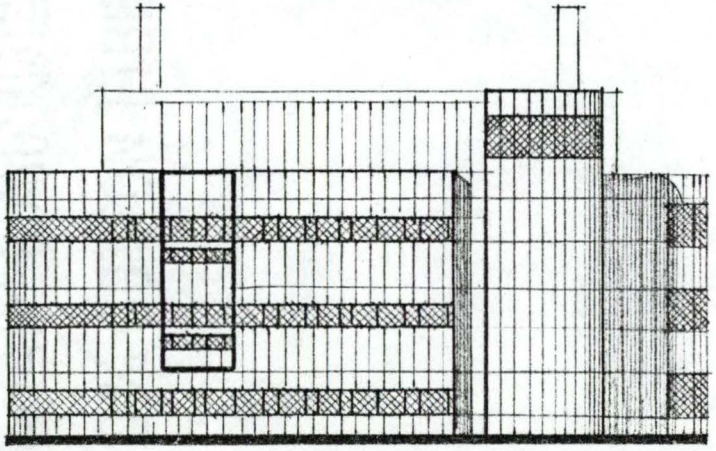

STORAGE
LAB.
STERILIZATION
MECH.
BASEMENT
OFFICES
LABS
SPECIAL PURPOSE
LABS
FIRST FLOOR
OFFICES
CLASSRM
LOUNGE
LABS
SPECIAL PURPOSE
LABS
SECOND FLOOR



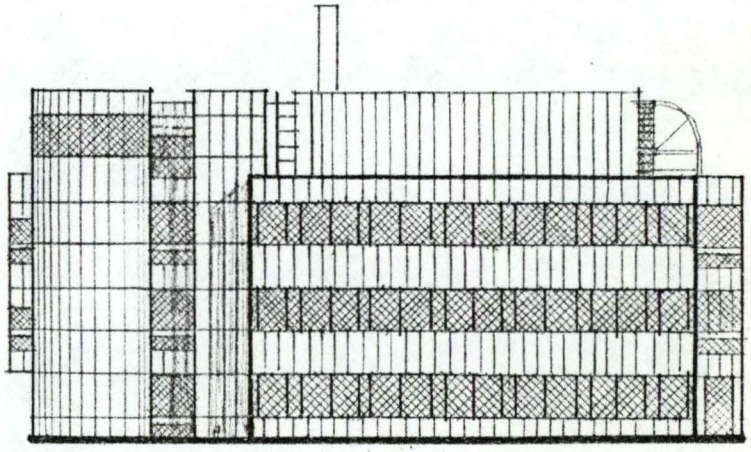
North



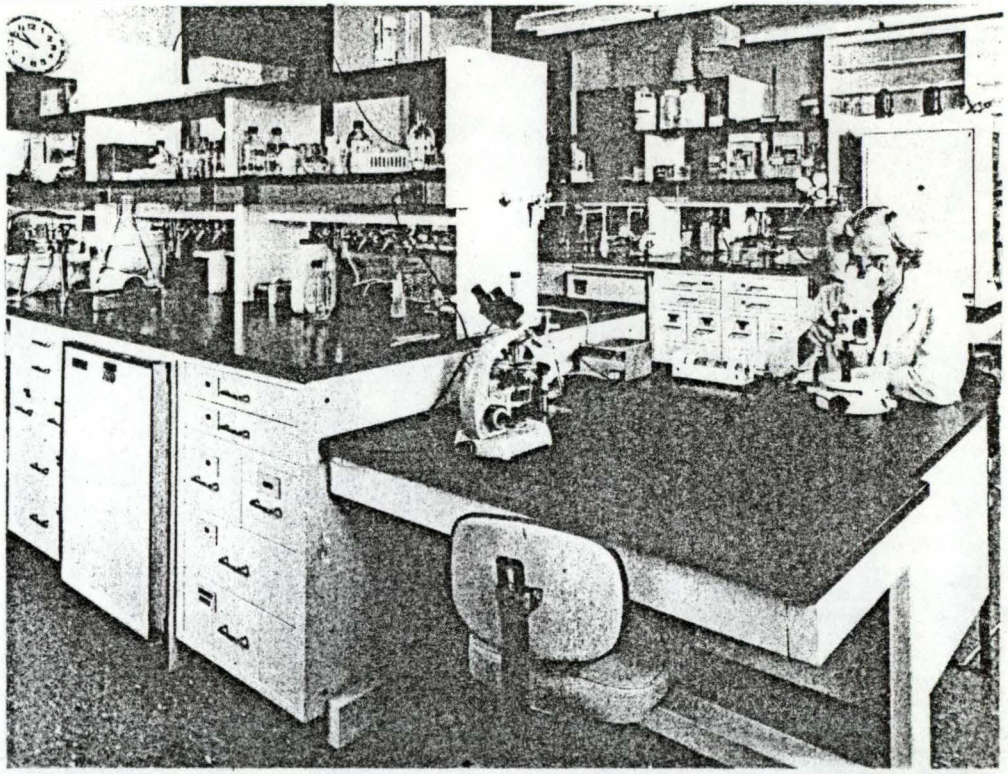
West

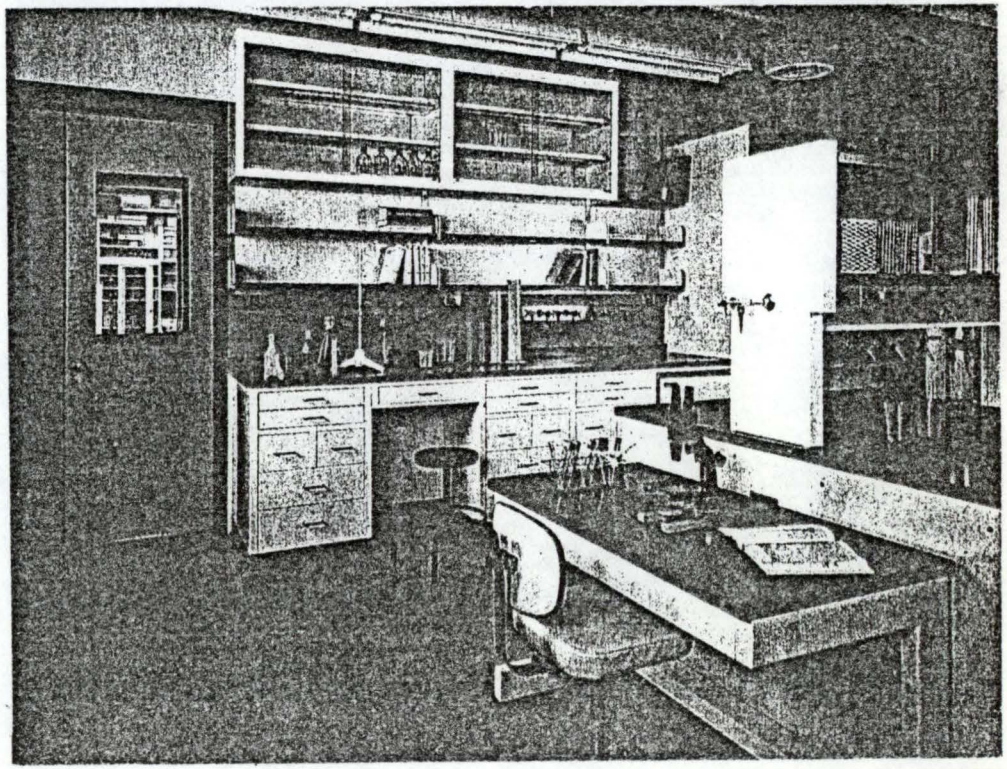


South



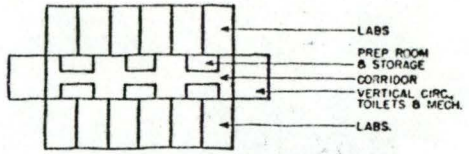
East



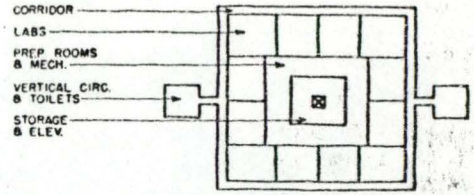


DESIGN CRITERIA

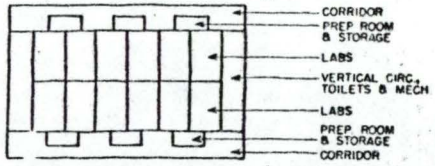
LABORATORIES



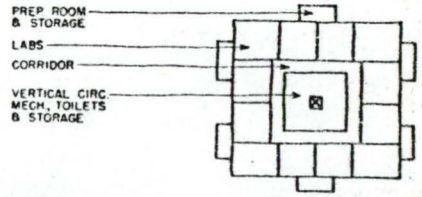
Feasibility: *Structural:* Compact plan may reduce cost. *Mechanical:* Although cores are separated, short mechanical runs reduce cost. *Circulation:* Double loaded corridors most economical. *Flexibility:* Changes may be made easily.



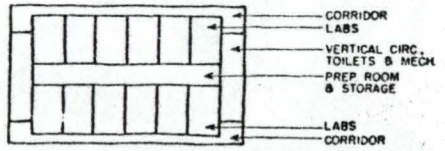
Feasibility: *Structural:* Economical arrangement. *Mechanical:* Very compact and economical. *Circulation:* Excessive corridors. *Flexibility:* Fair.



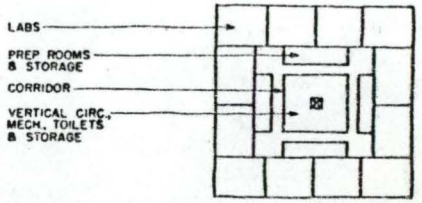
Feasibility: *Structural:* Compact plan. *Mechanical:* Separated cores and double runs of ducts, etc. may add to cost. *Circulation:* Doubling number of corridors is uneconomical. *Flexibility:* Rooms may be changed and added with ease.



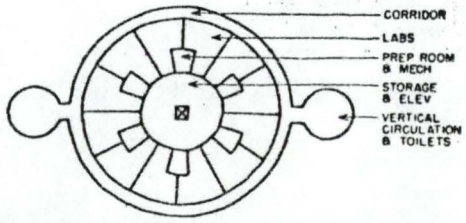
Feasibility: *Structural:* Fairly economical. *Mechanical:* Very compact and economical. *Circulation:* Very economical corridor arrangement. *Flexibility:* Fair.



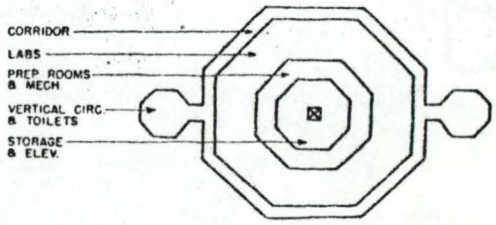
Feasibility: *Structural:* Compact plan may reduce cost. *Mechanical:* Compact system may reduce cost. *Circulation:* Double corridors uneconomical. *Flexibility:* Not as flexible as scheme above.



Feasibility: *Structural:* Economical arrangement. *Mechanical:* Very compact and economical. *Circulation:* Minimum length of corridors. *Flexibility:* Rooms changed and additions made easily.

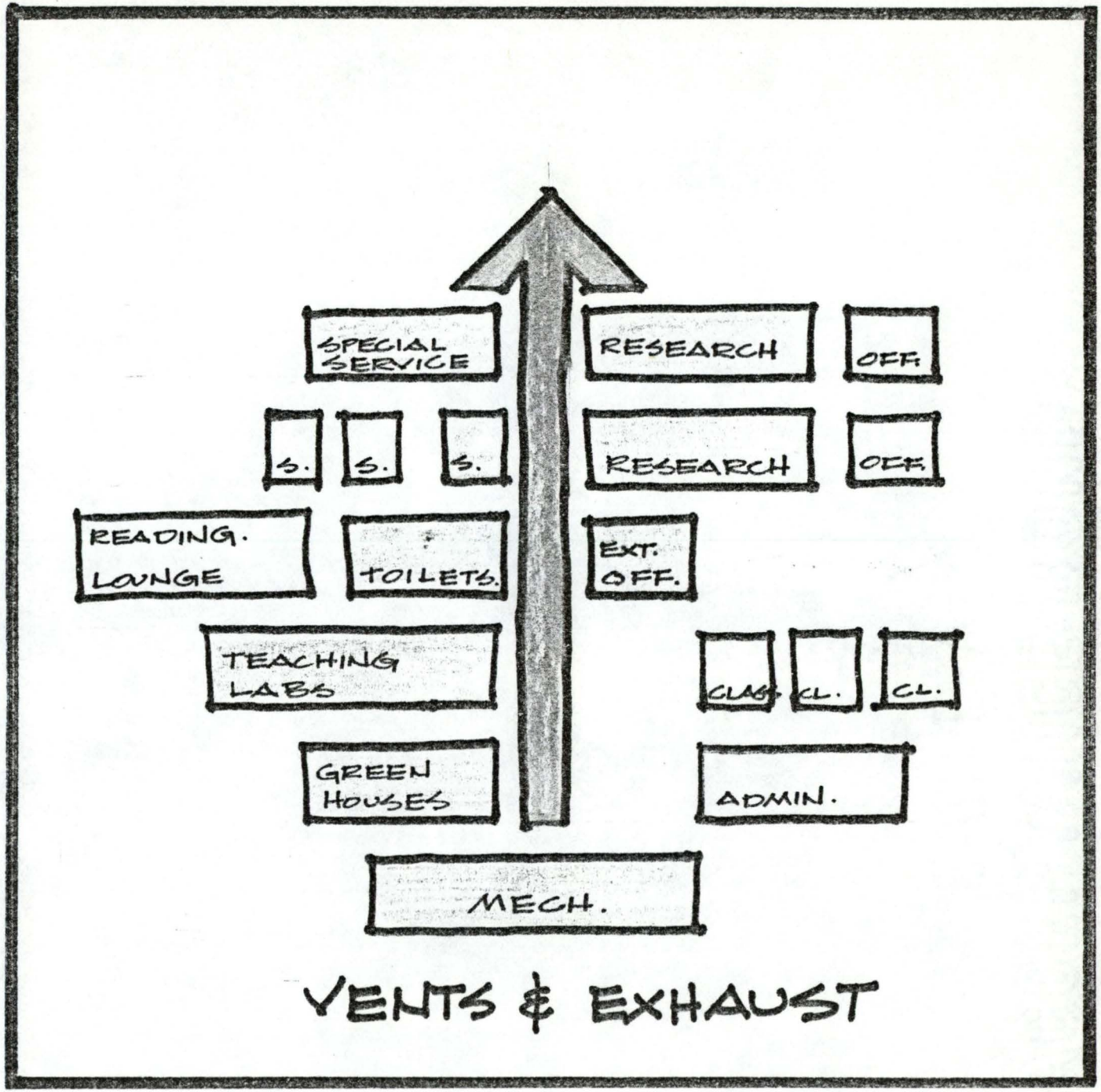


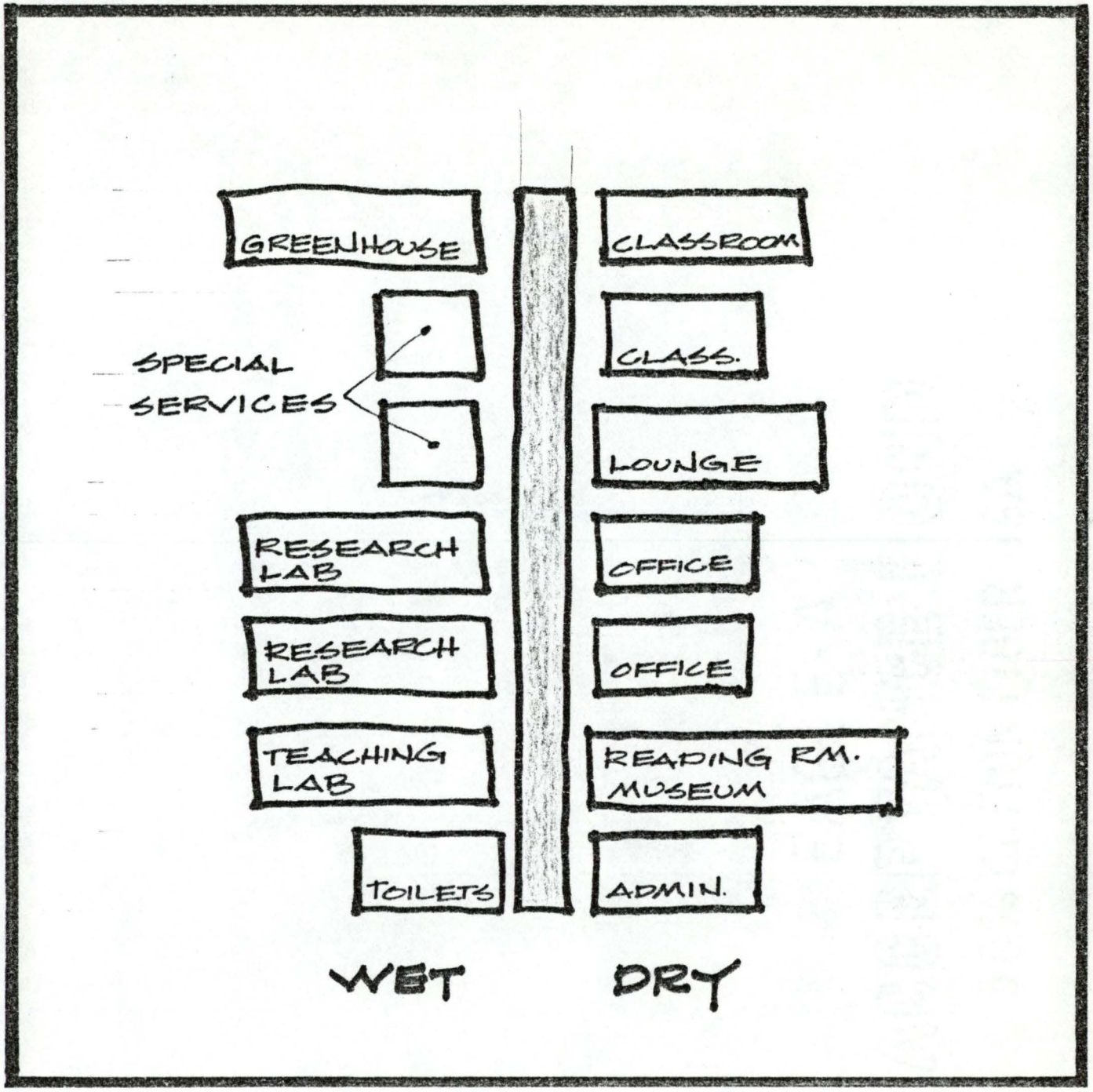
Feasibility: *Structural:* Good form for economical structure. *Mechanical:* Very compact and economical. *Circulation:* Excessive corridors. *Flexibility:* Not too flexible.

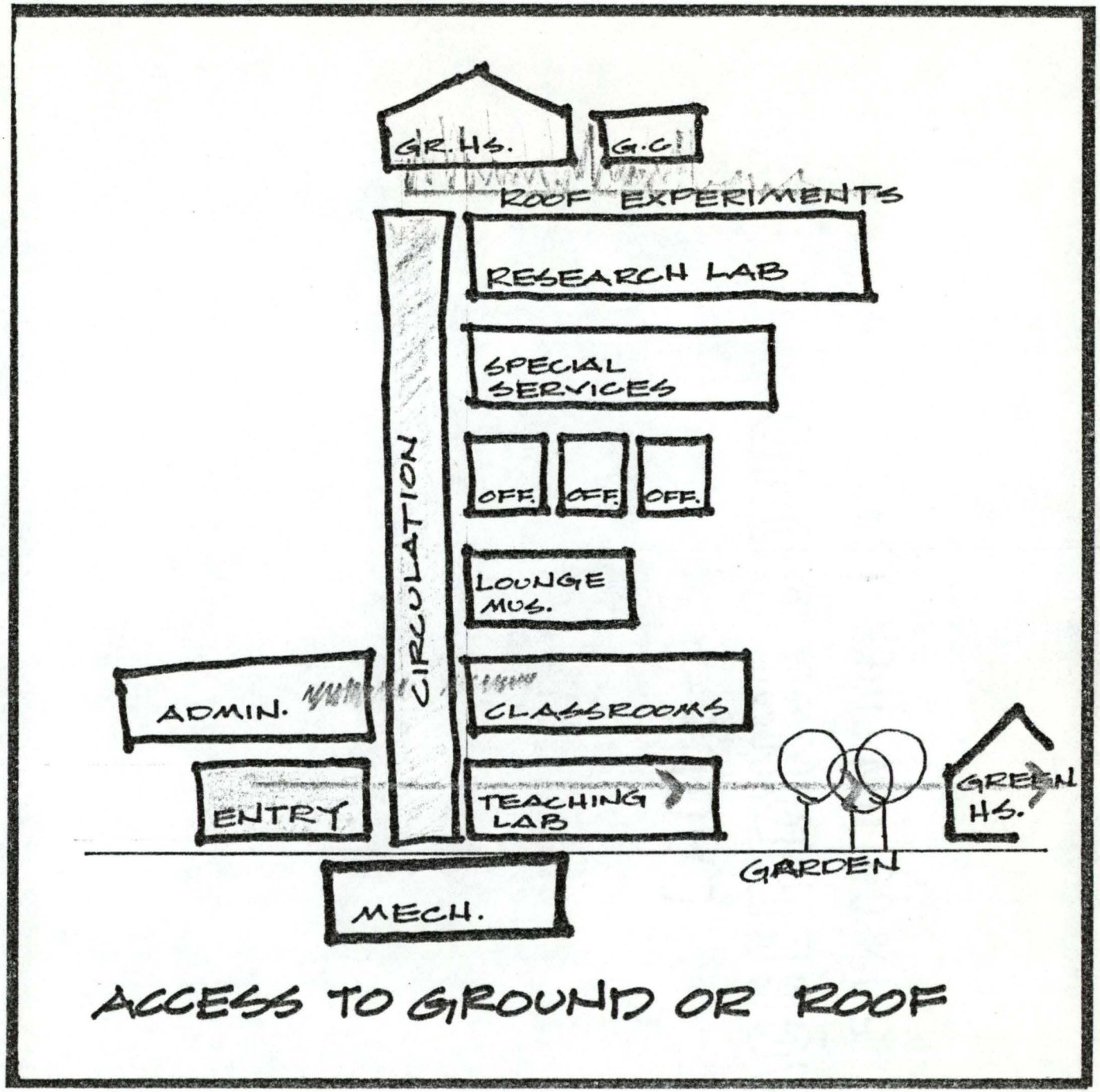


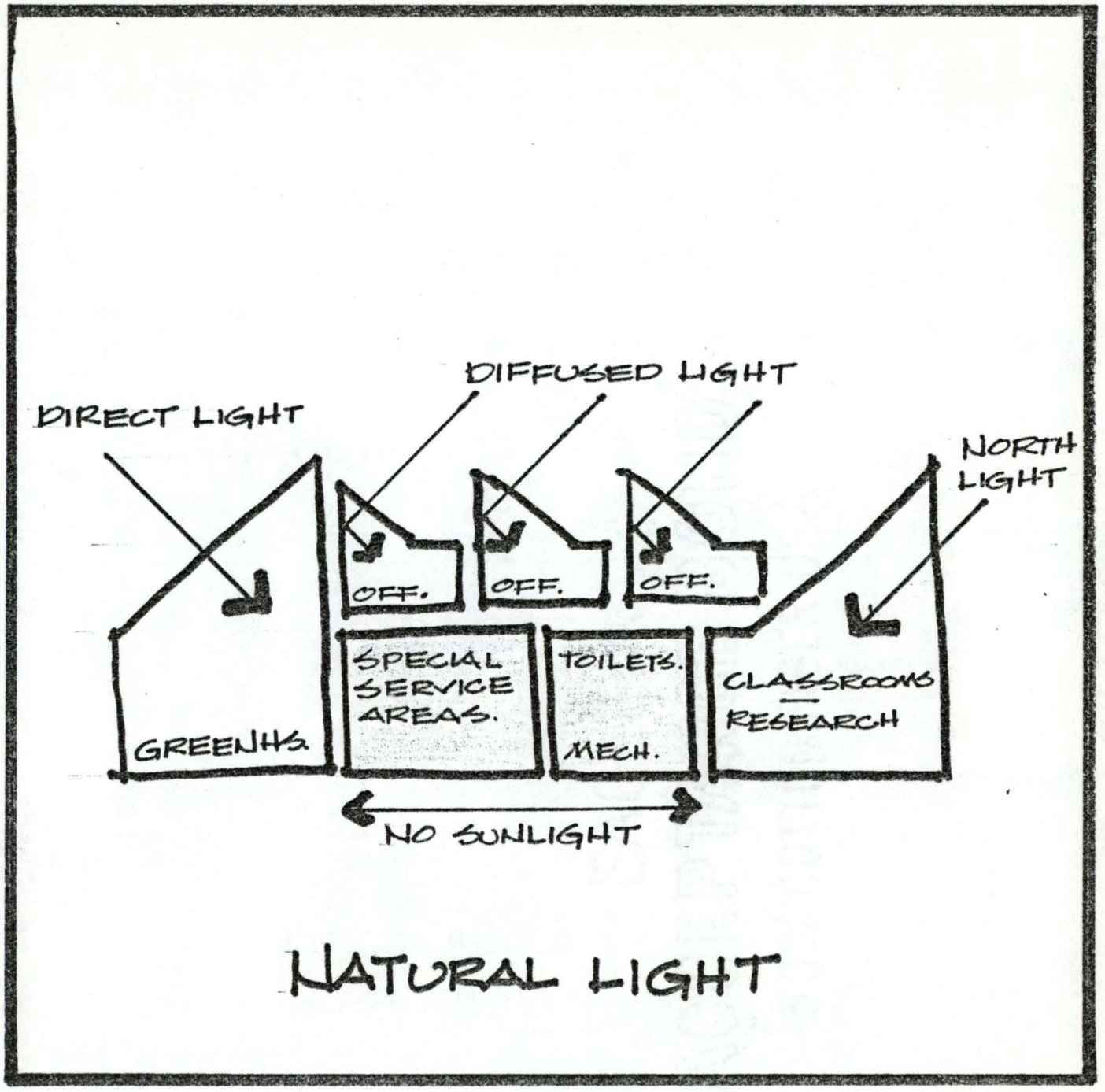
Feasibility: *Structural:* Economical structure. *Mechanical:* Very compact and economical. *Circulation:* Excessive corridors. *Flexibility:* Not too flexible.

Fig. 4 Comparative study of different teaching laboratory layouts by Hellmuth, Obata, and Kassabaum, with an evaluation of each in terms of economy and flexibility.


SPECIAL SERVICE
RESEARCH
OFF.
S.
S.
S.
RESEARCH
OFF.
READING. LOUNGE
TOILETS.
EXT. OFF.
TEACHING LABS
CLAS
CL.
CL.
GREEN HOUSES
ADMIN.
MECH.
VENTS & EXHAUST


GREENHOUSE
SPECIAL SERVICES
RESEARCH LAB
RESEARCH LAB
TEACHING LAB
TOILETS
CLASSROOM
CLASS.
LOUNGE
OFFICE
OFFICE
READING RM. MUSEUM
ADMIN.
WET
DRY


GR. Hs.
G.C.
ROOF EXPERIMENTS
RESEARCH LAB
SPECIAL SERVICES
OFF.
OFF.
OFF.
CIRCULATION
LOUNGE MUS.
ADMIN.
CLASSROOMS
ENTRY
TEACHING LAB
GREEN HS.
GARDEN
MECH.
ACCESS TO GROUND OR ROOF



NATURAL LIGHT

UNIVERSITY GUIDELINES

Building Guidelines established by the University relate principally to scale and materials. The Master plan states that "the success of the Clemson campus in terms of its visual impact upon residents and visitors lies in the unity and human scale that is produced by the juxaposition of small buildings within the large open spaces of the campus. Most campus buildings are brick faced and those constructed since the 1950's consistently use a salmon colored brick.

The buildings are generally three to four stories, except for the occasional tower forms such as Strode Tower and the High-rise dormatories. These tower forms are capable of serving as orientation landmarks and additionally lend variety to the campus skyline, providing they are not within the historic area of the campus where they would compete with the Tilman Hall Tower.

Of equal importance to the shape or texture of individual buildings are the campus spaces created by them. These spaces will vary from similar and more intimate spaces developed by the clustering of three to four buildings to the large open spaces between building clusters.

THE PROGRAM

SPACE REQUIREMENTS

The spaces and corresponding areas represent a summary of data compiled from the individual departments. However, these figures do not protray a definite program, but, instead attempt to act as a base from which the designer can inquire into the architecture.

DEPARTMENT OF AGRONOMY AND SOILS:

Personnel	Number	Square Feet	Area
Administration			1240
Faculty	29	160	4640
Staff (inc. word proc.)	8	160	1280
Grad Students	35	70	2450
Technicians	17	160	2720
Conference Room	1		250
Reading Room	1		900
Instruction			
* Classrooms	2	900	1800
** Classrooms	2	540	1080
Laboratories	8	900	7200
Lab Storage	8	150	1200
Research			
Laboratories	12	900	10800
Lab Storage	12	150	1800
Extension, General Use	2	900	1800
Special Services			
Instrument Complex	2	900	1800
A-T Lab	1	625	625
Material Prep.	1	900	900
Audioclave	1	400	400
Chemical Storage	1	300	300
Soil Sample Room	1	250	250
Greenhouse	-		1800
		TOTAL AREA	45,235

* each needed 13 hours/week
** each needed 10 hours/week

DEPARTMENT OF ENTOMOLOGY, WILDLIFE AND FISHERIES

Personnel	Number	Square Feet	Area
Administration	1		1120
Faculty	37	160	5920
Staff	15	160	2400
Grad Students	66	70	4620
Technicians	22	160	3520
Service Area	1		160
Conference	1		250
Reading Room	1		900
Instruction			
* Classrooms	3	1260	3780
** Classrooms	2	720	1440
Insect Museum	1		1000
Fish Museum	1	500	500
Museum Storage	1	160	160
Curator's Lab	1	250	250
Dry Laboratories	9	900	8100
Wet Laboratories	1	900	900
Lab Storage	10	160	1600
Research			
Extension, General	4	900	3600
Entomology Research	16	900	14,400
Wildlife Research	2	900	1800
Fisheries Research	2	900	1800
Lab Storage	24	150	3600
Special Services			
Rearing Rooms	10	110	1100
Isotope Room	1	200	200
Pesticide Room	1	300	300
Growth Chamber	1	900	900
Necropsy Room	1	350	350
Cold Rooms	2	180	360
Media & Cleaning	1	300	300
Instrument Room	3	200	600

Isolation Room	2	220	440
Animal rooms	2	200	400
Darkroom	1	300	300
Chemical Center	1	280	280
Greenhouses			3200
		TOTAL AREA	70,550

* each needed 12 hours/week
** each needed 10 hours/week

DEPARTMENT OF HORTICULTURE

Personnel	Number	Square Feet	Area
Administration	1		1280
Faculty	28	160	4480
Staff	9	70	1750
Grad Students	25	70	1750
Technicians	30	160	4800
Conference	1		250
Reading room			900
Instruction			
* Classrooms	2	1260	2520
** Classrooms	4	720	2880
Dry Labs	6	900	5400
Wet Labs	3	900	2700
Drafting	2	1200	2400
Lab Storage	11	150	1650
Research			
Extension, General Use	2	900	1800
Research Laboratories	12	900	10800
Lab Storage	14	150	2100
Special Services			
Audioclave	1	200	200
Media Prep	1	200	200
Growth Chambers	6	65	390
Plant Samples	1	400	400
Post Harvest	1	1500	1500
Greenhouses			22,400
		TOTAL AREA	72,550

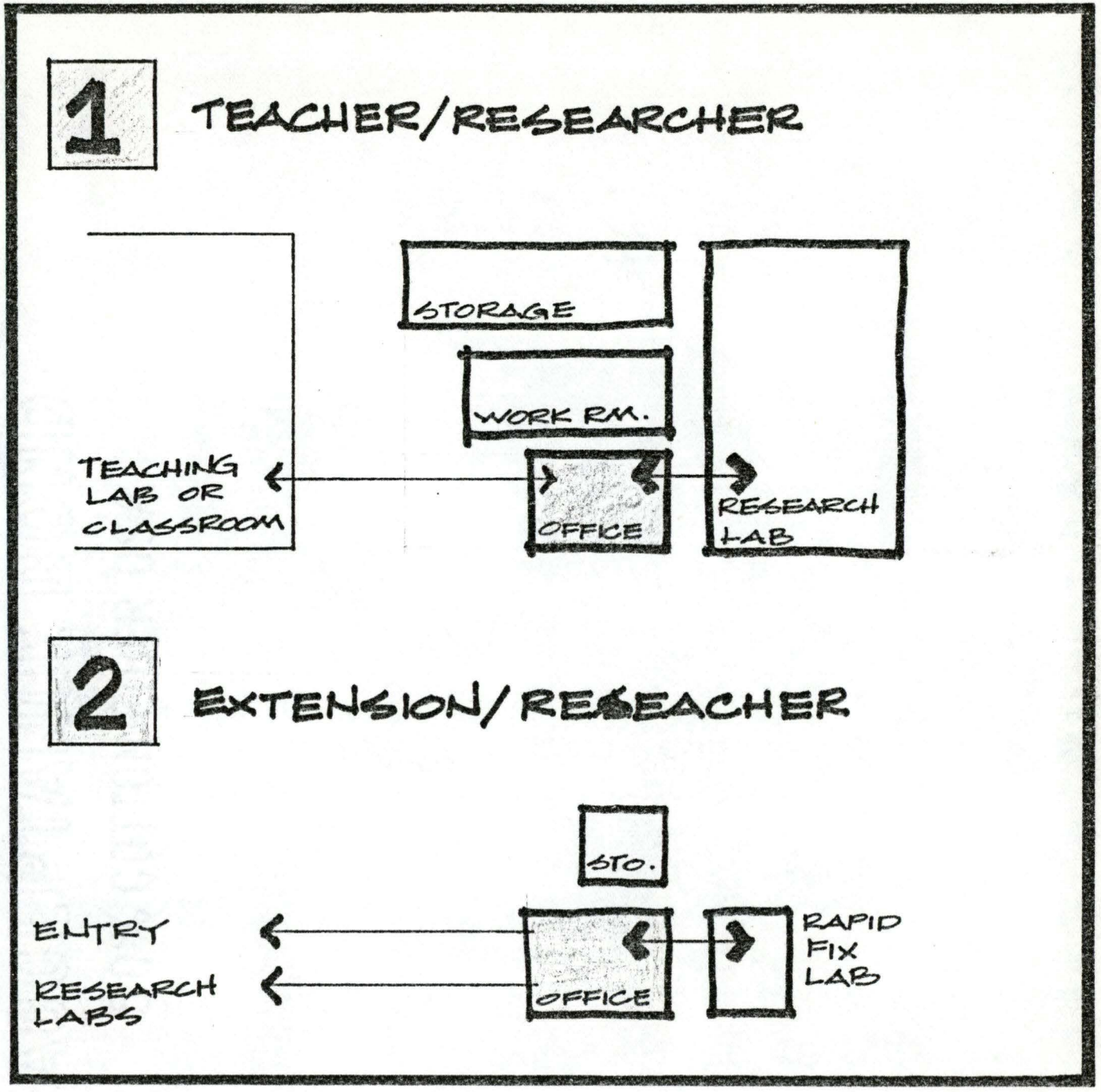
DEPARTMENT OF PLANT PATHOLOGY AND PHYSIOLOGY

Personnel	Number	Square Feet	Area
Administration	1		1200
Faculty	15	160	2400
Staff	8	160	1280
Grad students	15	70	1050
Technicians	19	160	3040
Conference	1		250
Reading Room	1		900
Instruction			
Classrooms	1	1100	1100
Classrooms	2	450	900
Wet Labs/Optical	2	1100	2200
Plant Physiology	1		600
Research			
Plant Pathology	12	900	10,800
Plant Physiology	2	900	1800
Extension Research	3	900	2700
Lab Storage	17	150	2550
Special Services			
Cold Rooms	1	180	180
Growth Chambers	1	900	900
Instrument Room	1	200	200
Incubator Room	1	150	150
Chemical Storage	1	280	280
Radioscope Room	1	300	300
Greenhouse			12,800
		TOTAL AREA	47,580

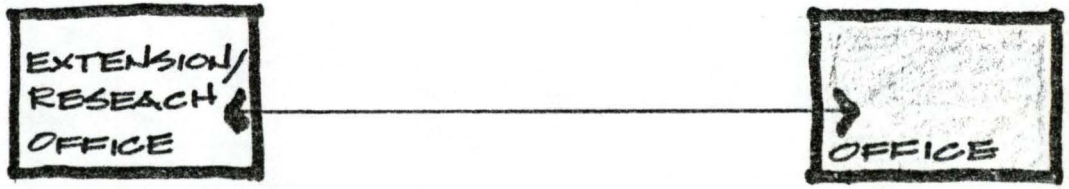
Department of Agronomy and Soils:		
Personnel	13,480	
Instructional	11,280	
Research	14,400	
Special Services	6,075	
		45,235
Department of Entomology, Wildlife and Fisheries:		
Personnel	18,890	
Instructional	17,730	
Research	25,200	
Special Services	8,730	
		70,550
Department of Horiculture:		
Personnel	15,210	
Instructional	17,550	
Research	14,700	
Special Services	25,090	
		72,550
Department of Plant Pathology & Physiology:		
Personnel	10,120	
Instruction	4,800	
Research	17,850	
Special Service	14,810	
		47,580
SUBTOTAL		235,915

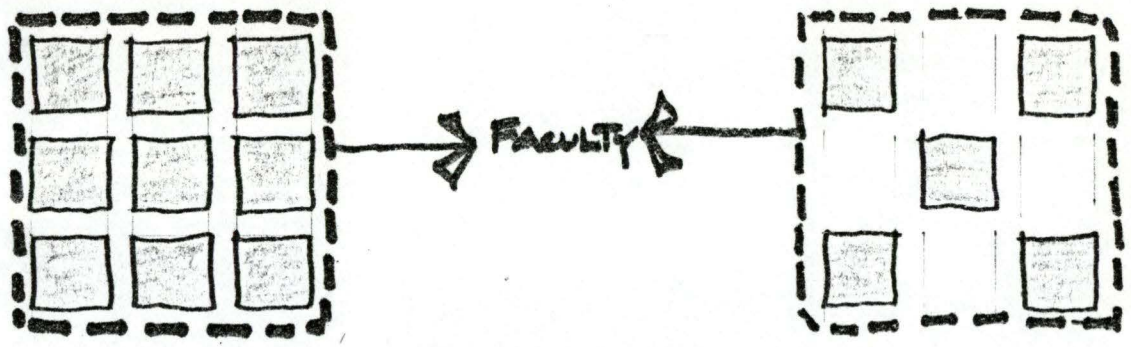
Inter-Departmental			
Personnel lounge		900	
Student lounge		1,000	
Auditorium		3,000	
SEM-TEM			
Communications		1,000	
Receiving/shipping		400	
Duplicating		300	
	NET TOTAL		242,815
	plus 30% =		72,845
	GROSS TOTAL		315,660

PERSONNEL		57,700
Instruction		
Classrooms		15,500
Laboratories		35,860
Research		72,150
Special Services		
Research Support		14,505
Greenhouses		40,200
Inter-Departmental		
Miscellaneous		6,900
Mechanical and Circulation		72,845
	TOTAL	315,660


1
TEACHER/RESEARCHER
STORAGE
WORK RM.
TEACHING LAB OR CLASSROOM
OFFICE
RESEARCH LAB
2
EXTENSION/RESEARCHER
STO.
ENTRY
RESEARCH LABS
OFFICE
RAPID FIX LAB

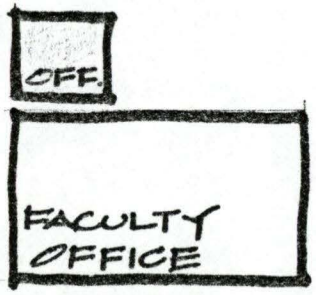
THE TERM STAFF APPLIES TO THOSE FACULTY MEMBERS THAT ARE NOT PHYSICALLY LOCATED ON CAMPUS, BUT REQUIRE AN OFFICE WHILE CONDUCTING ON-CAMPUS BUSINESS.

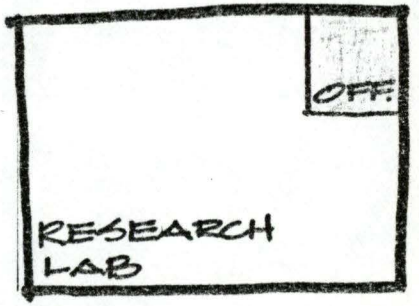




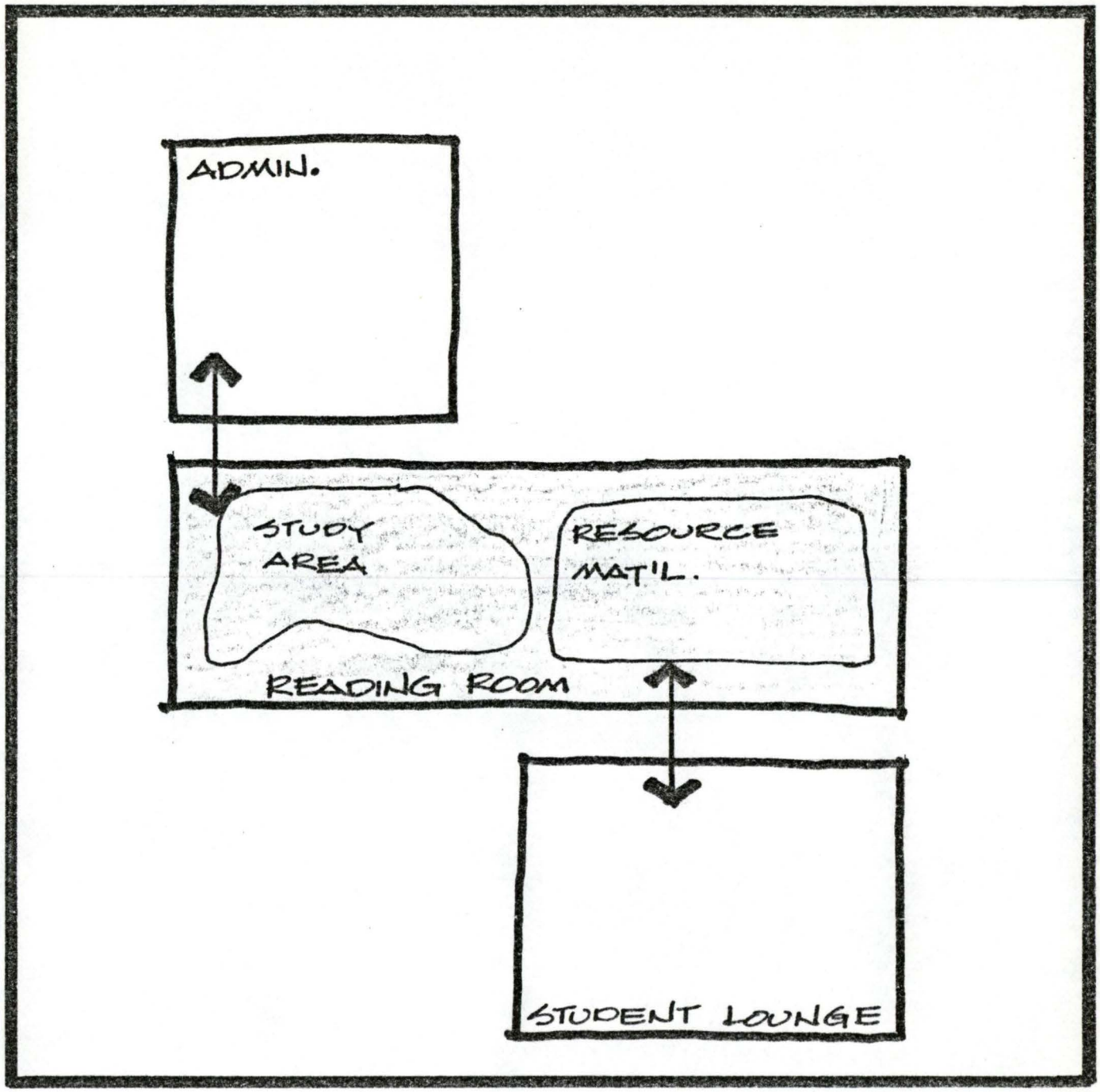
CARREL-TYPE SPACES
5-10 PERSONS/RM.

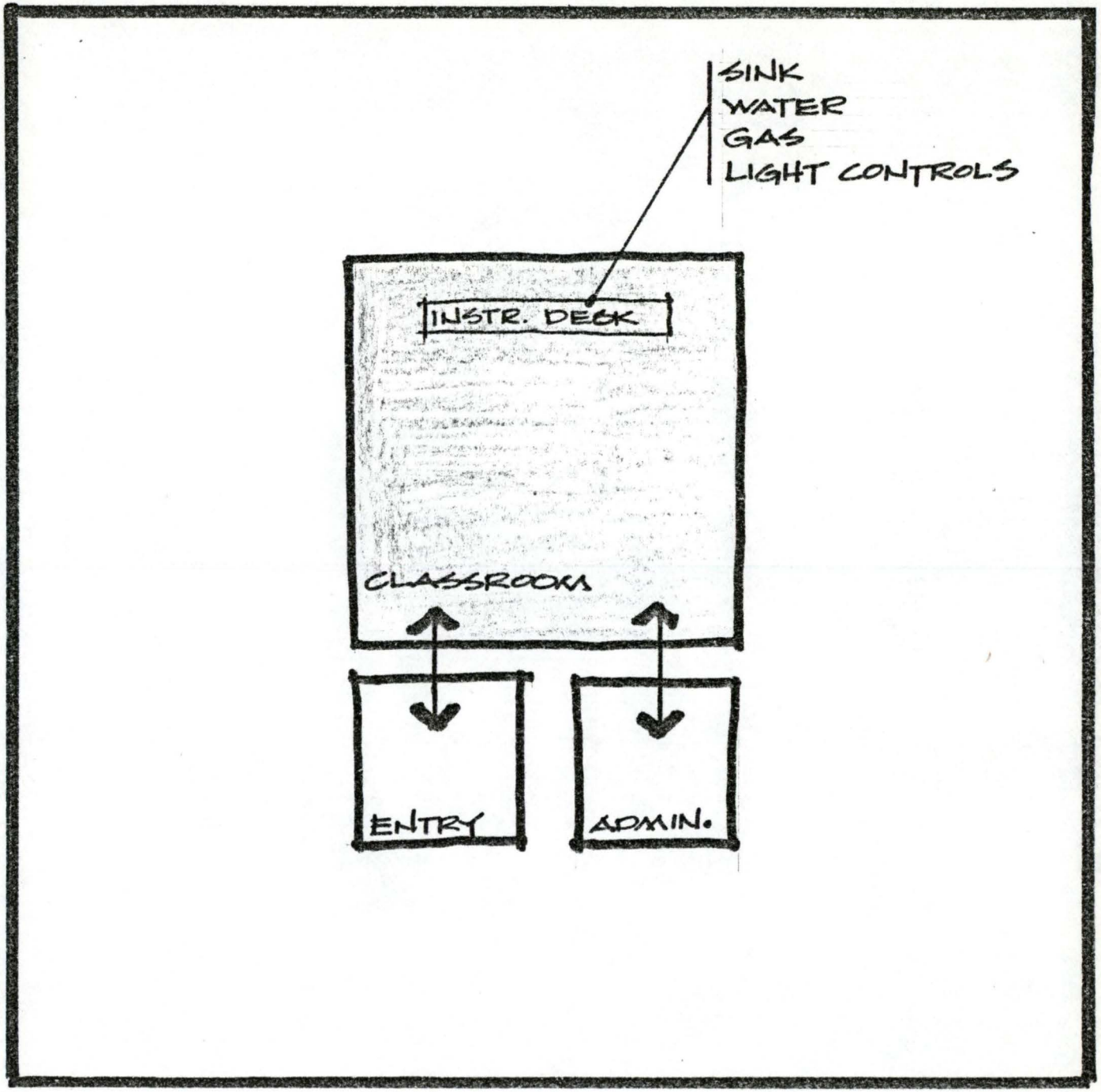
GRAD. STUDENTS

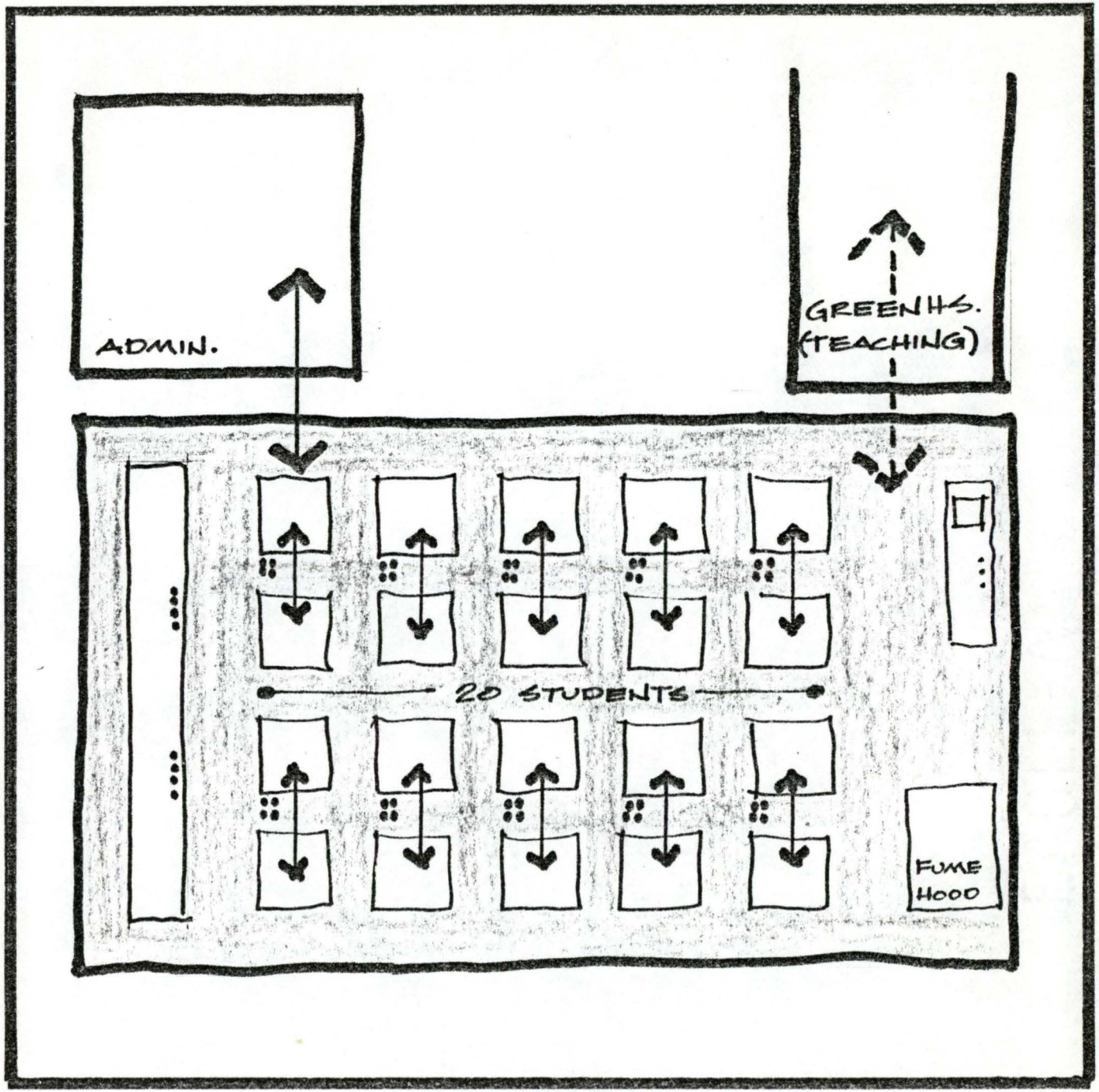


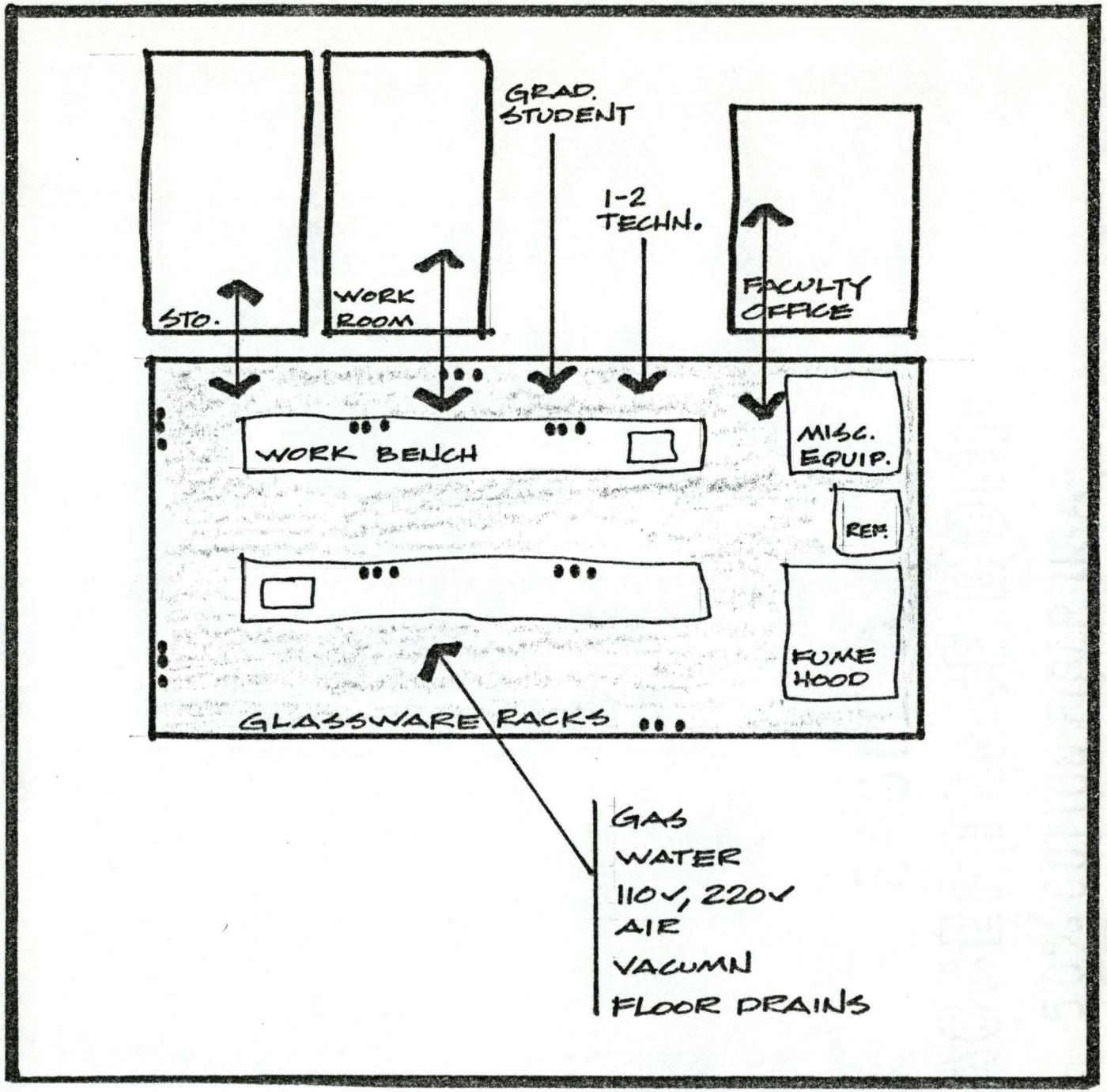


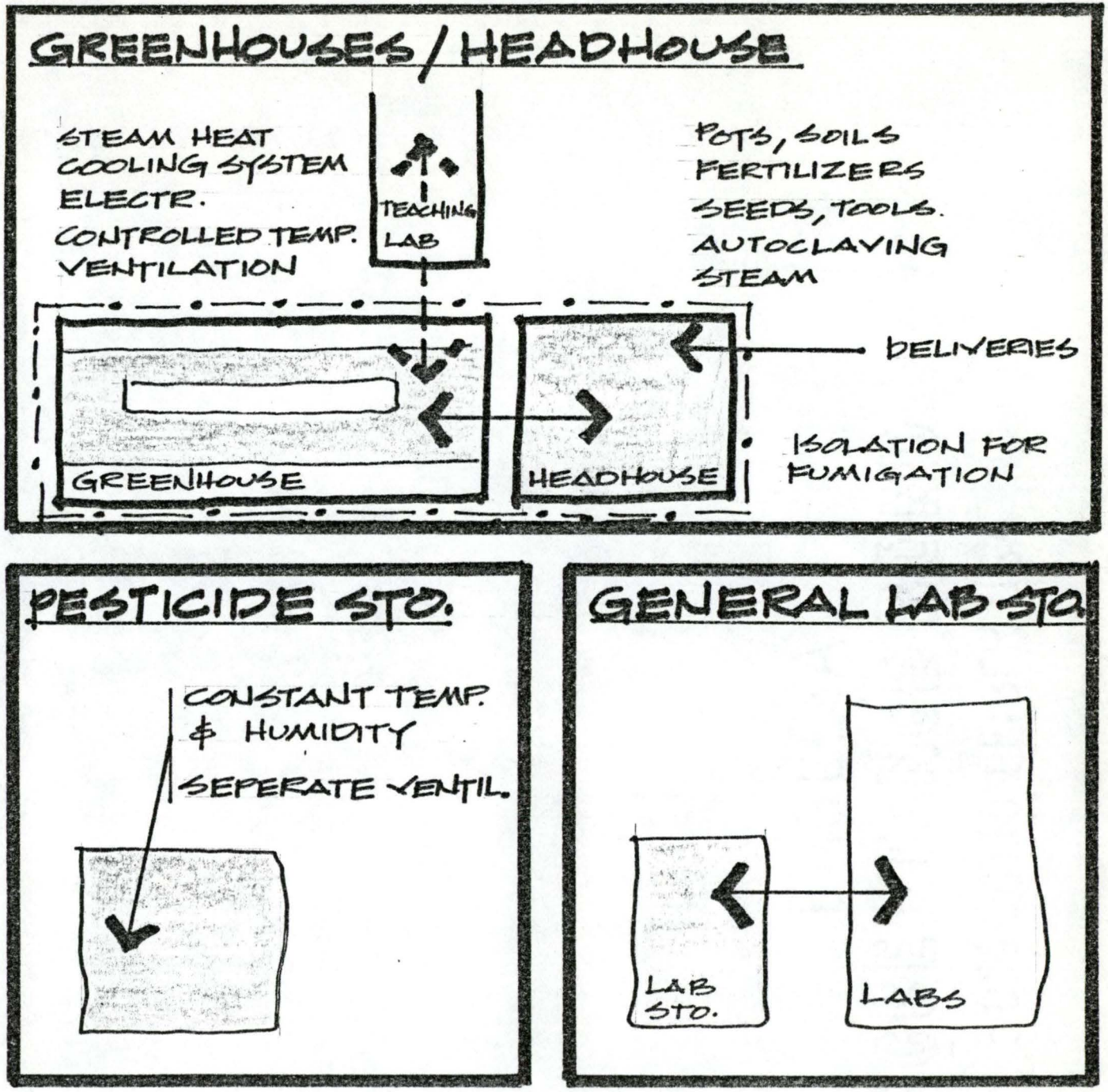
TECHNICIANS


ADMIN.
STUDY AREA
RESOURCE MAT'L.
READING ROOM
STUDENT LOUNGE


SINK
WATER
GAS
LIGHT CONTROLS
INSTR. DESK
CLASSROOM
ENTRY
ADMIN.

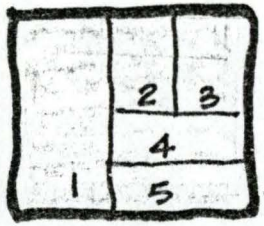

ADMIN.
GREENHS.
(TEACHING)
20 STUDENTS
FUME
HOOD


GRAD. STUDENT
1-2 TECHN.
STO.
WORK ROOM
FACULTY OFFICE
WORK BENCH
MISC. EQUIP.
REF.
FUME HOOD
GLASSWARE RACKS
GAS
WATER
110v, 220v
AIR
VACUMN
FLOOR DRAINS


GREENHOUSES / HEADHOUSE
STEAM HEAT
COOLING SYSTEM
ELECTR.
CONTROLLED TEMP.
VENTILATION
TEACHING LAB
POTS, SOILS
FERTILIZERS
SEEDS, TOOLS.
AUTOCLAVING
STEAM
DELIVERIES
ISOLATION FOR FUMIGATION
GREENHOUSE
HEADHOUSE
PESTICIDE STO.
CONSTANT TEMP. & HUMIDITY
SEPERATE VENTIL.
GENERAL LAB STO.
LAB STO.
LABS

SEM ROOM

1. SCANING ELECT. MICRO.
2. T.E.M.
3. DARK RM.
4. SECTIONING RM.
5. PREP. LAB

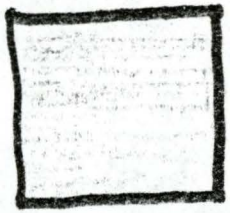


SEP. FOUNDATION

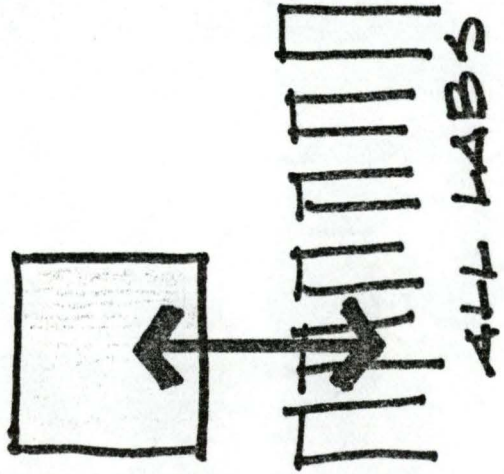
INSECT REARING

SEPERATE VENTILATION SYSTEM

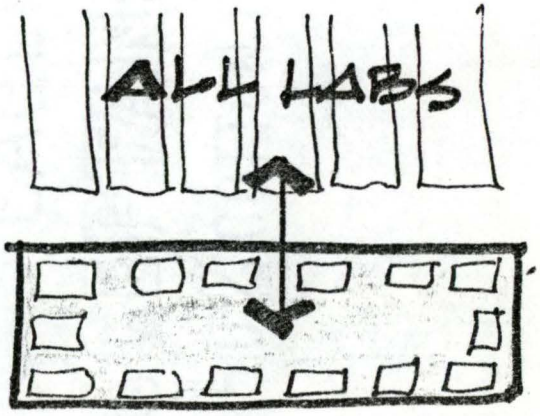
GAS, WATER, VACUMN AIR.



DARK ROOM

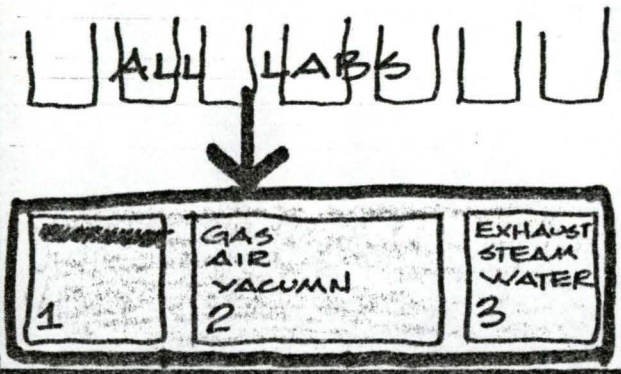


INCUBATOR RMS.

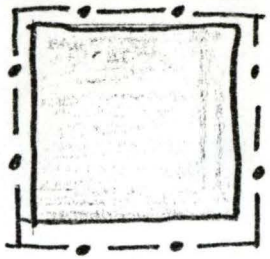


AUTOCLAVE

1. DISHWASHING
2. MEDIA PREP.
3. AUTOCLAVE

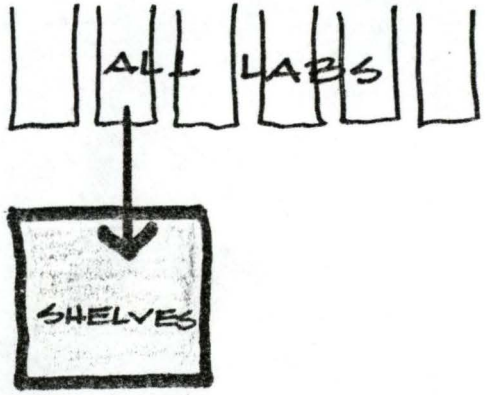


STERILE CULTURE



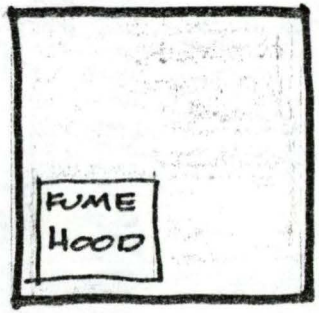
STEAM STERILIZED
ULTA-VIOLET LIGHT
A/C W/+ AIR PRESSURE
GAS, WATER, VACUMN

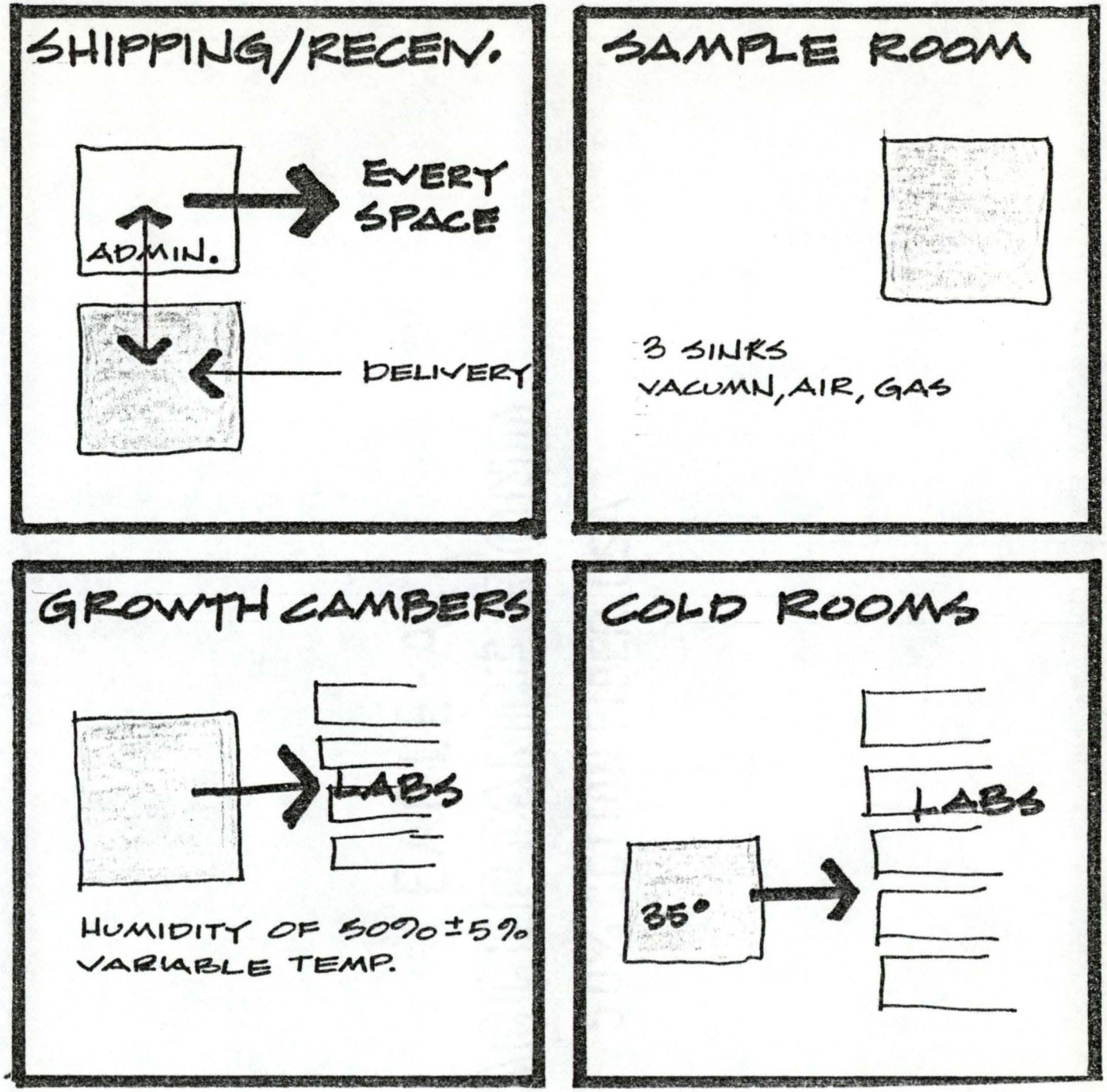
INSTRUMENT RM.

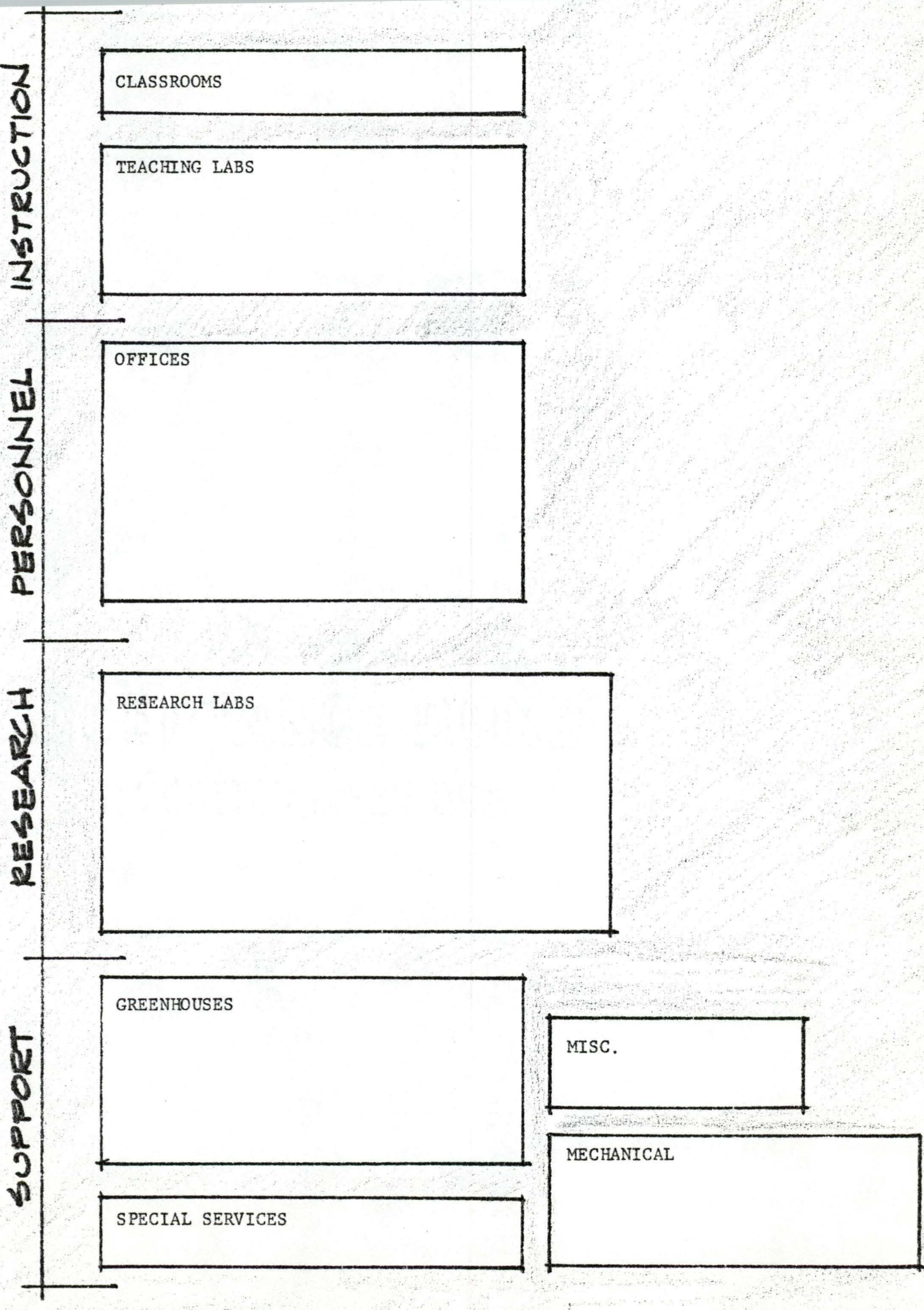


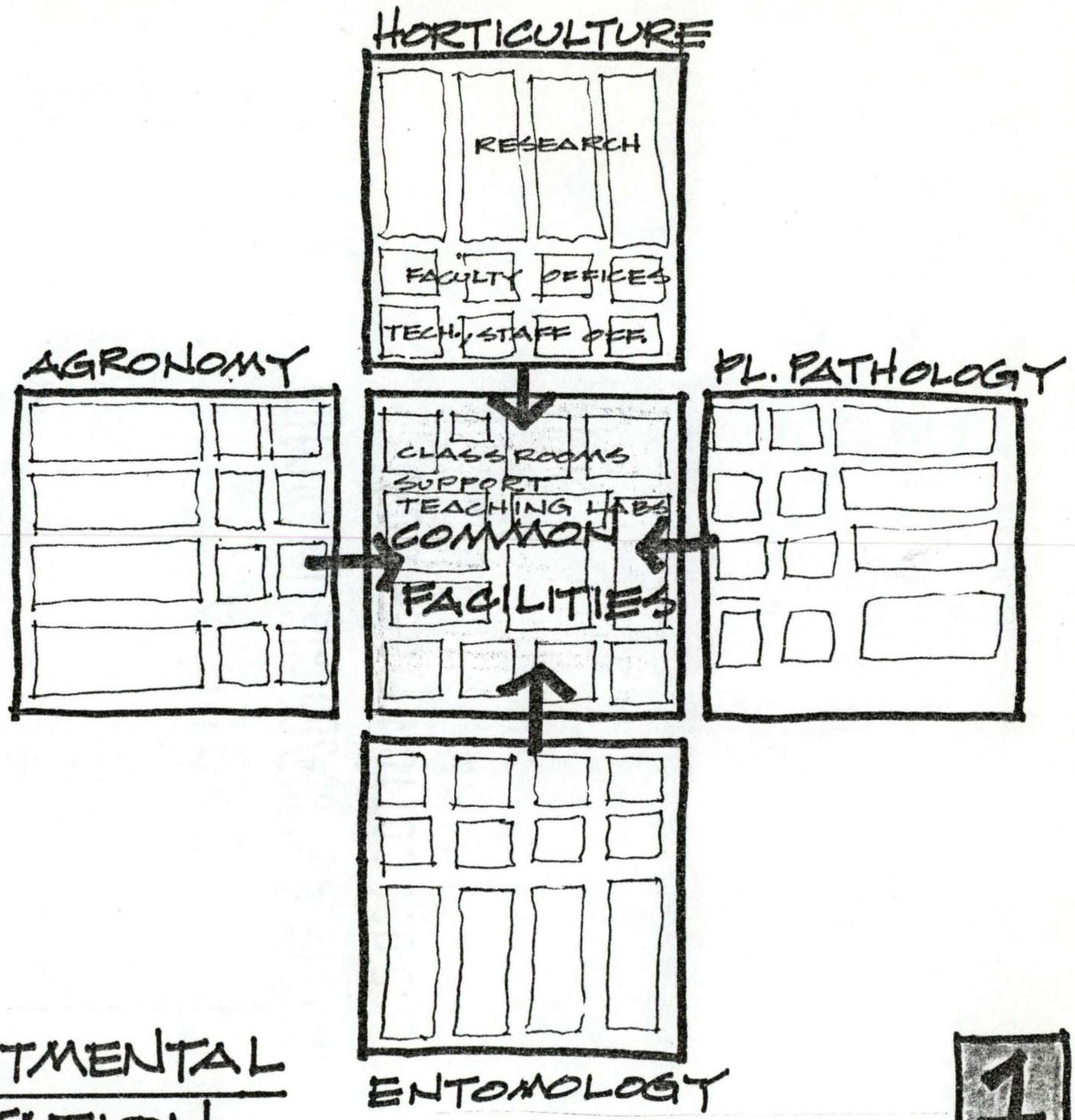
ISOTOPE WK. RM.

GAS
AIR
VACUMN
WATER




SHIPPING/RECEIV.
EVERY SPACE
ADMIN.
DELIVERY
SAMPLE ROOM
3 SINKS
VACUMN, AIR, GAS
GROWTH CAMBERS
LABS
HUMIDITY OF 50% ±5%
VARIABLE TEMP.
COLD ROOMS
LABS
35°

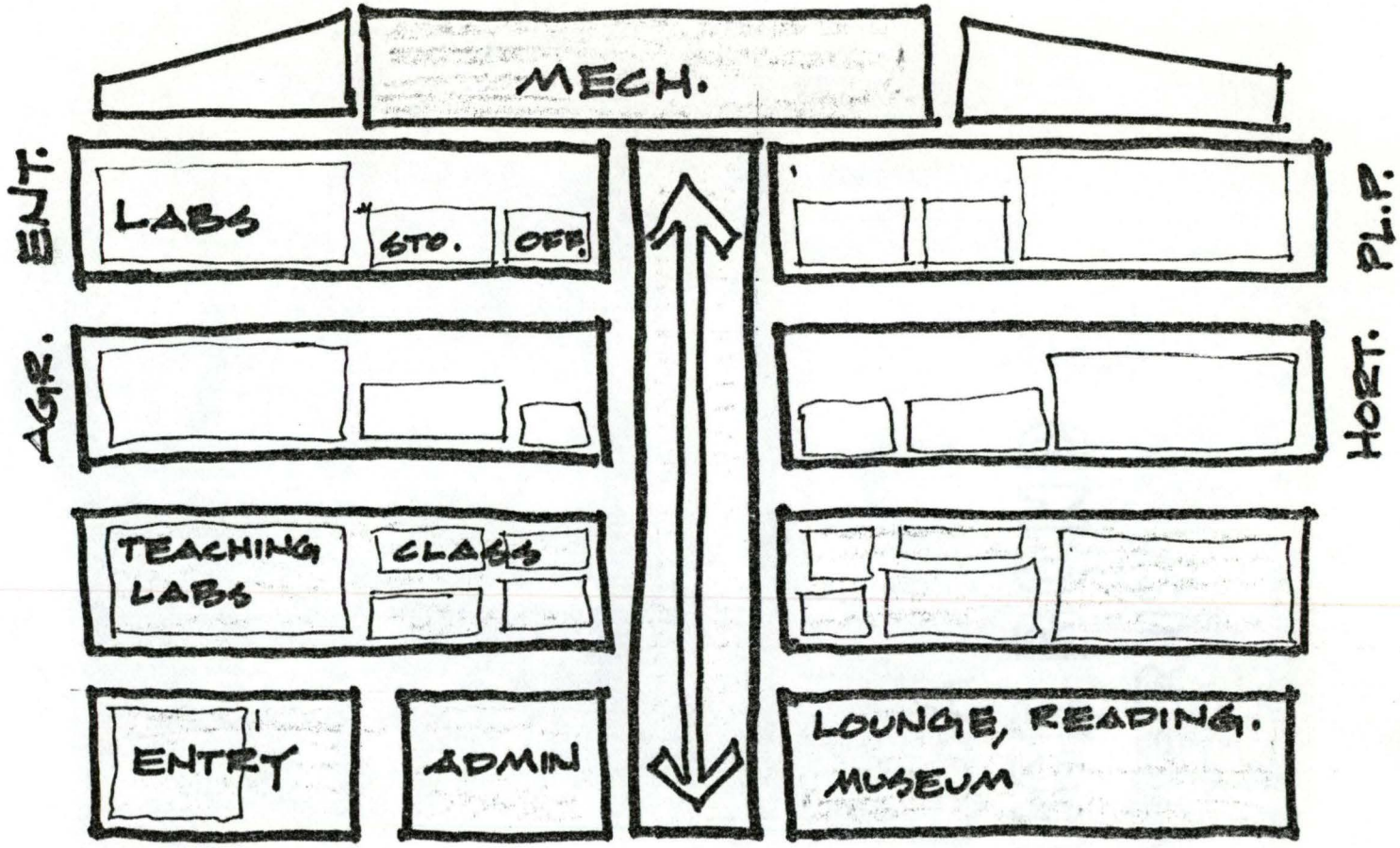

INSTRUCTION
CLASSROOMS
TEACHING LABS
PERSONNEL
OFFICES
RESEARCH
RESEARCH LABS
SUPPORT
GREENHOUSES
MISC.
MECHANICAL
SPECIAL SERVICES



DEPARTMENTAL ORIENTATION

BY WINGS OF BLDG.

1

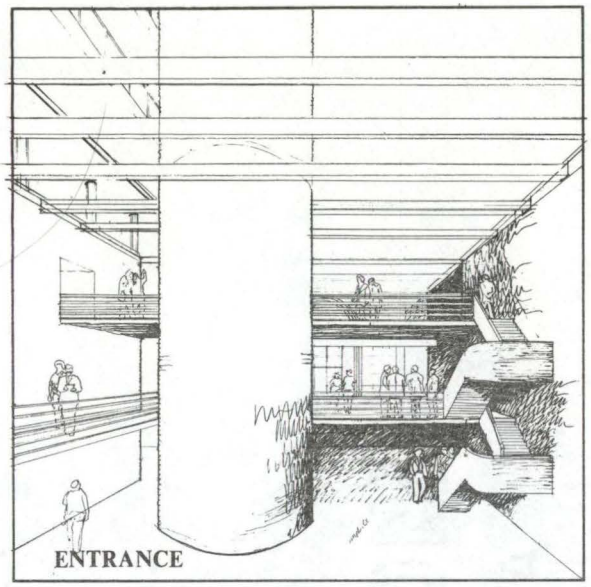


DEPARTMENTAL ORIENTATION

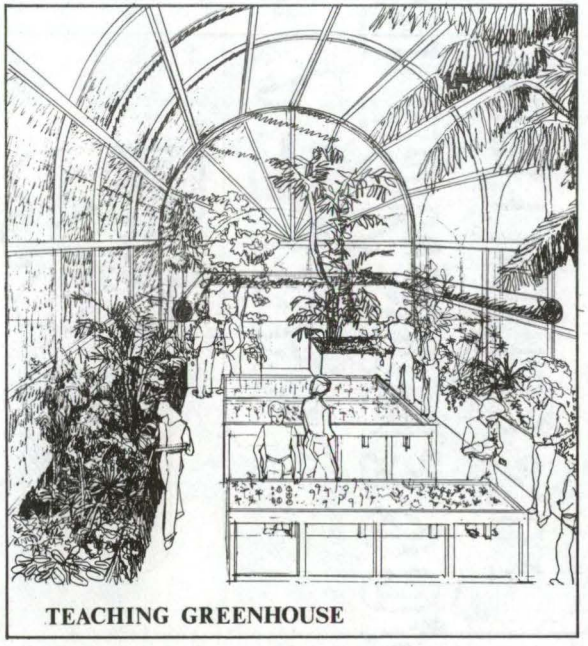
BY VERT. STACKING.

2

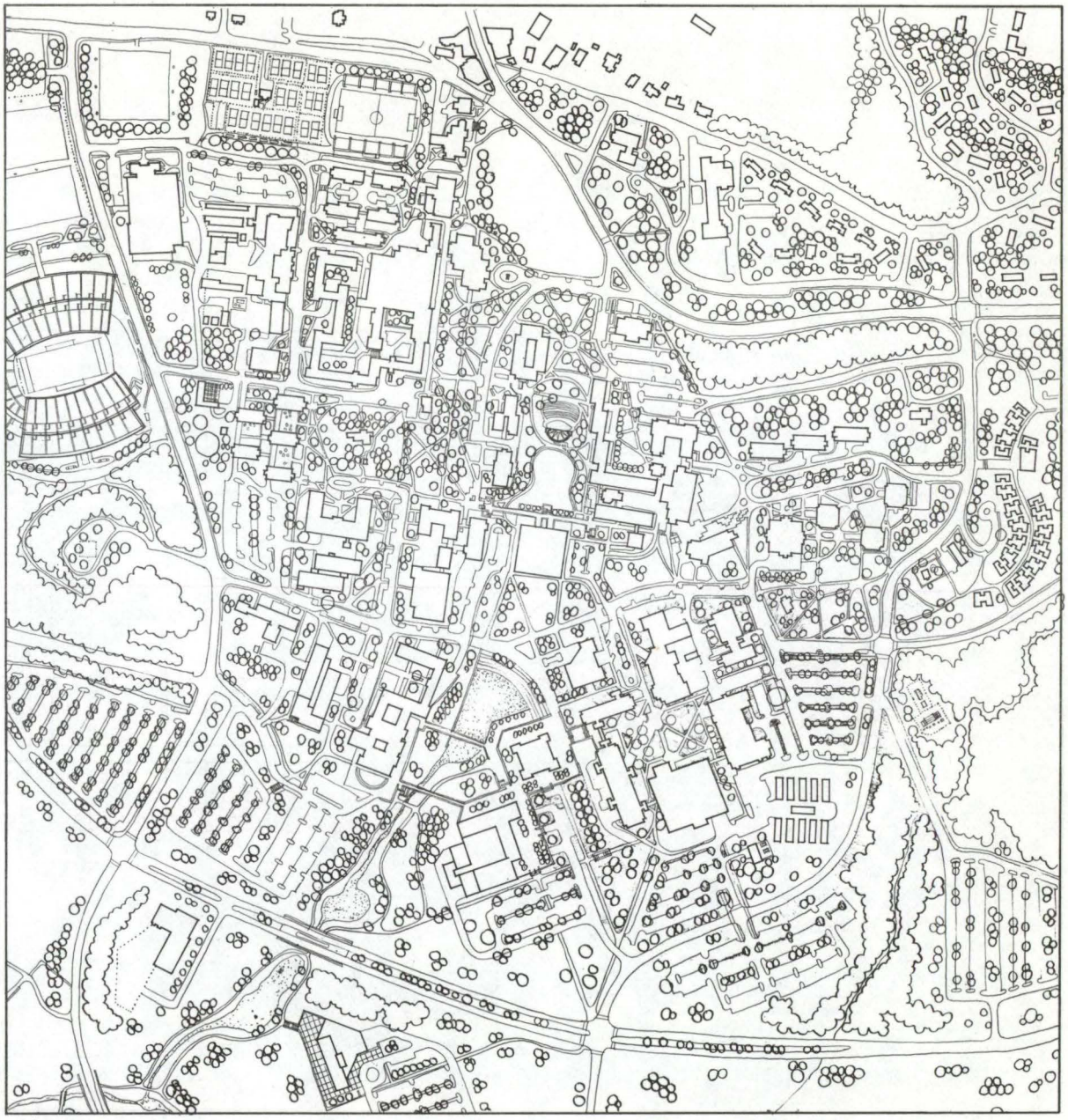
THE DESIGN PROPOSAL



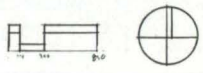
ENTRANCE

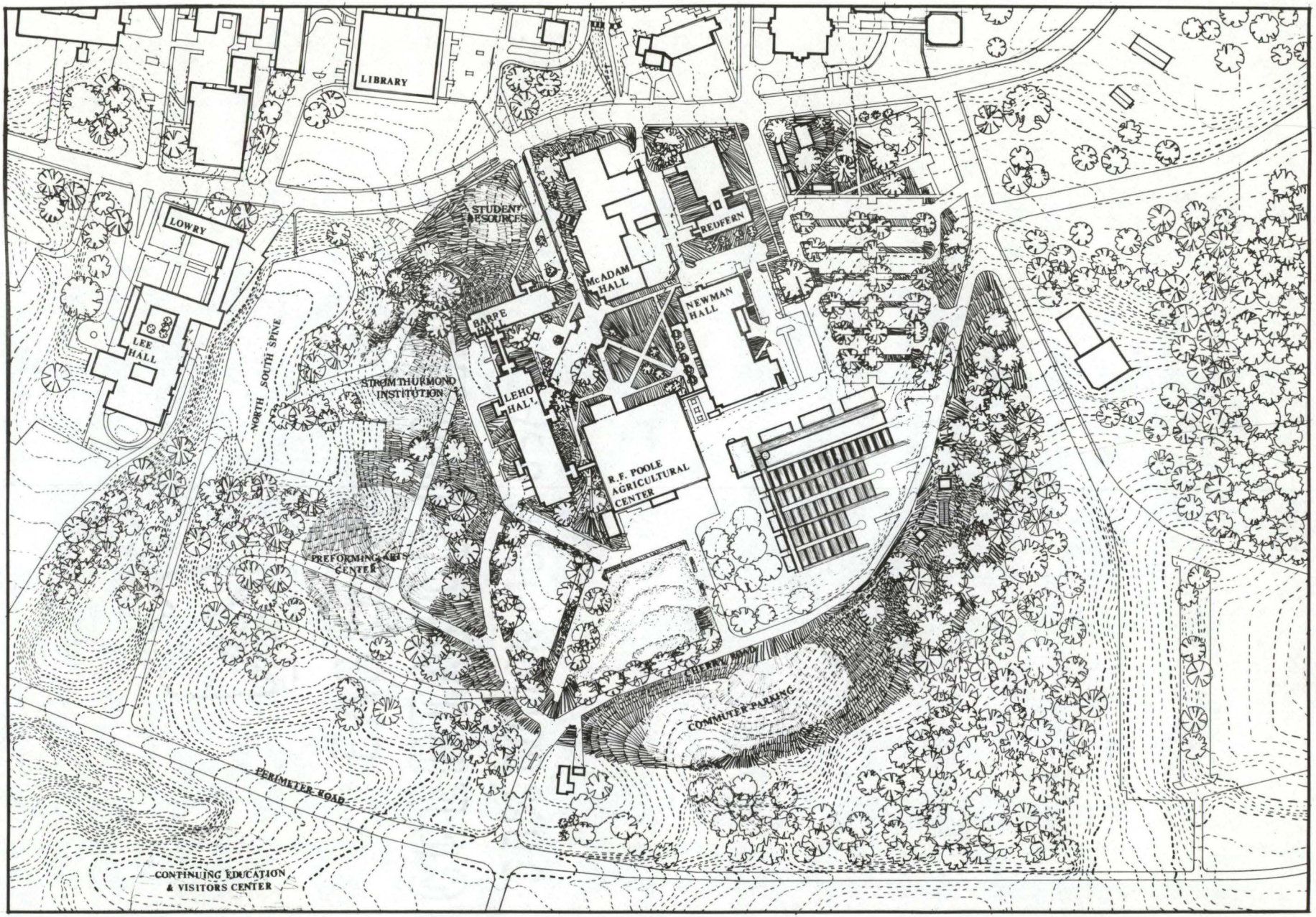


TEACHING GREENHOUSE

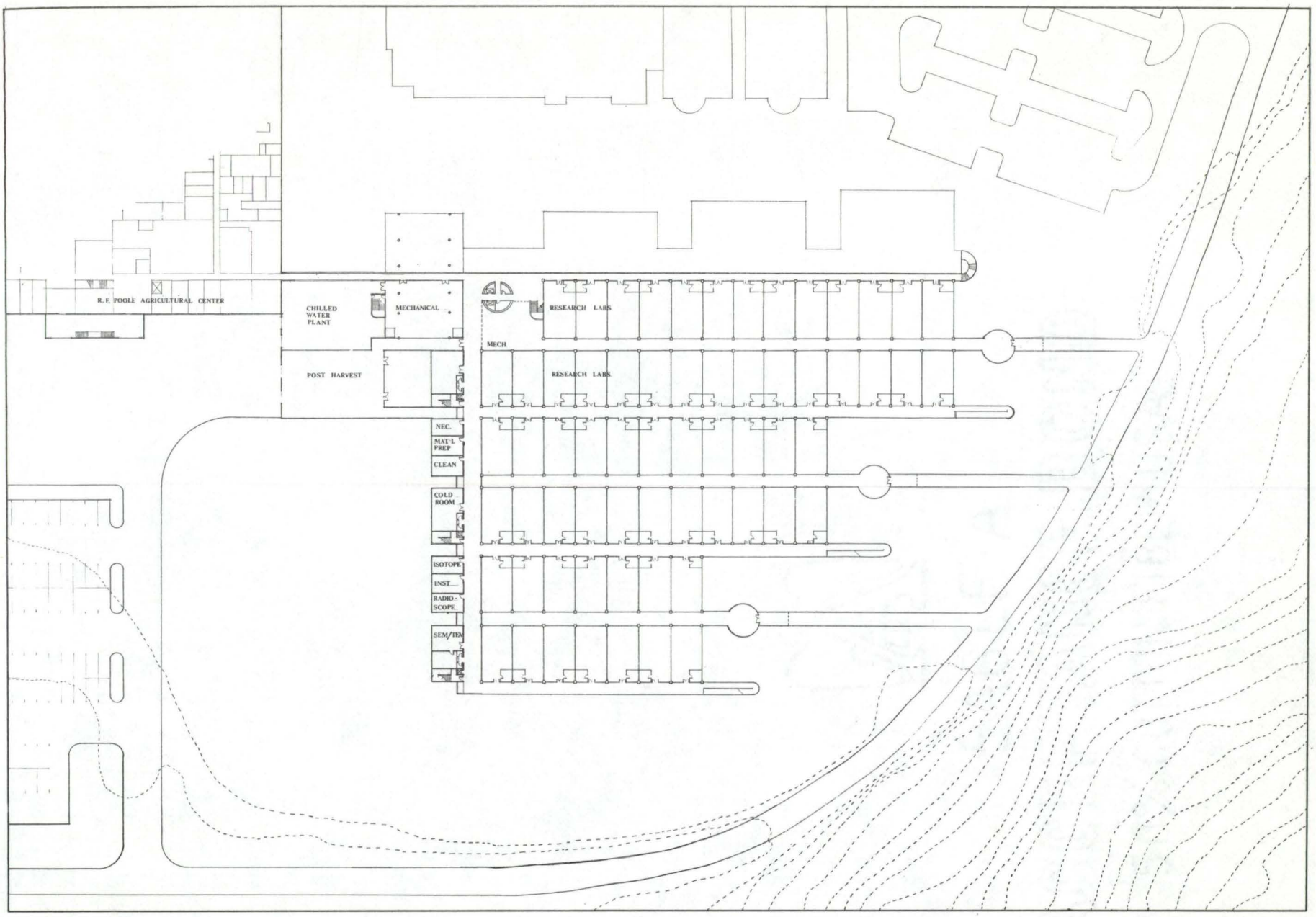


PLANT SCIENCE BUILDING

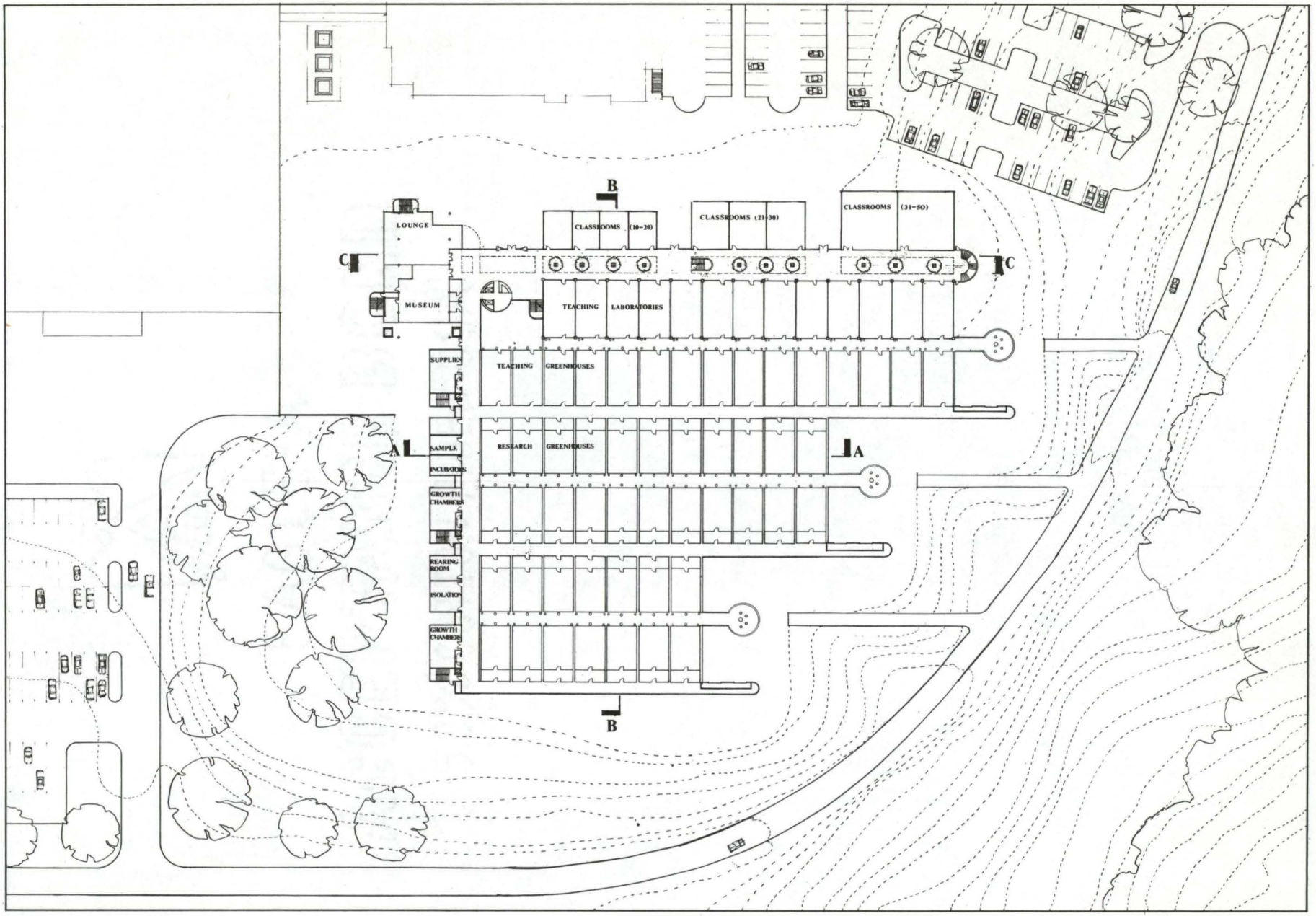



LIBRARY
LOWRY
LEE HALL
STUDENT RESOURCES
REDFERN
McADAM HALL
NEWMAN HALL
BARRE HALL
LEHOTSKY HALL
R.F. POOLE AGRICULTURAL CENTER
NORTH SOUTH SPINE
STROM THURMOND INSTITUTION
PREFORMING ARTS CENTER
CHERRY ROAD
COMMUTER PARKING
PERIMETER ROAD
CONTINUING EDUCATION & VISITORS CENTER

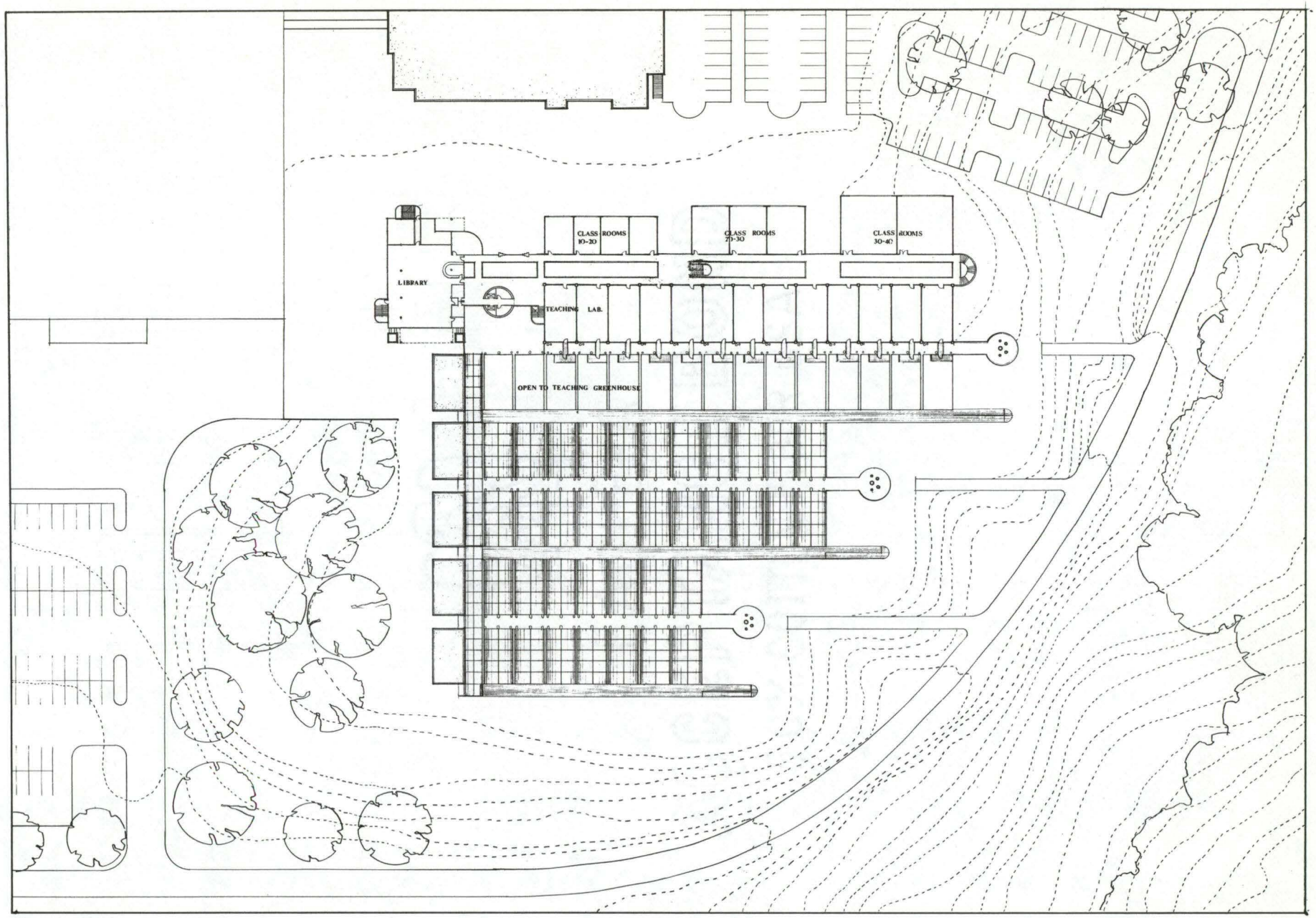
SITE


R. F. POOLE AGRICULTURAL CENTER
CHILLED WATER PLANT
MECHANICAL
POST HARVEST
MECH
RESEARCH LABS
RESEARCH LABS
NEC.
MAT'L PREP
CLEAN
COLD ROOM
ISOTOPE
INST.
RADIO-SCOPE
SEM/TEM

LEVEL 1

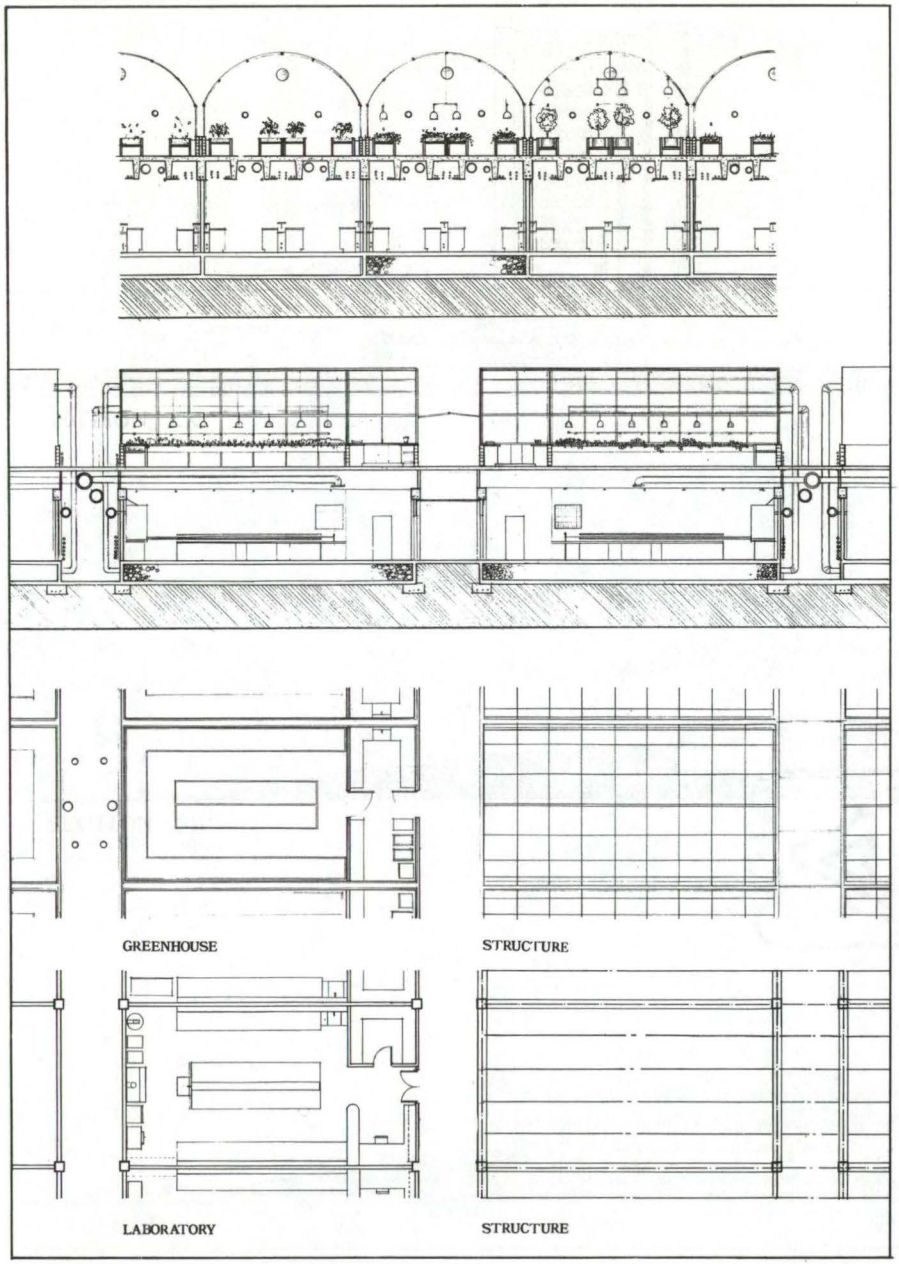

LOUNGE
MUSEUM
CLASSROOMS (10-20)
CLASSROOMS (21-30)
CLASSROOMS (31-50)
TEACHING LABORATORIES
TEACHING GREENHOUSES
RESEARCH GREENHOUSES
SUPPLIES
SAMPLE
INCUBATORS
GROWTH CHAMBERS
REARING ROOM
ISOLATION
GROWTH CHAMBERS
A
B
C
0 5 15 50

LEVEL 2

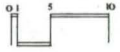


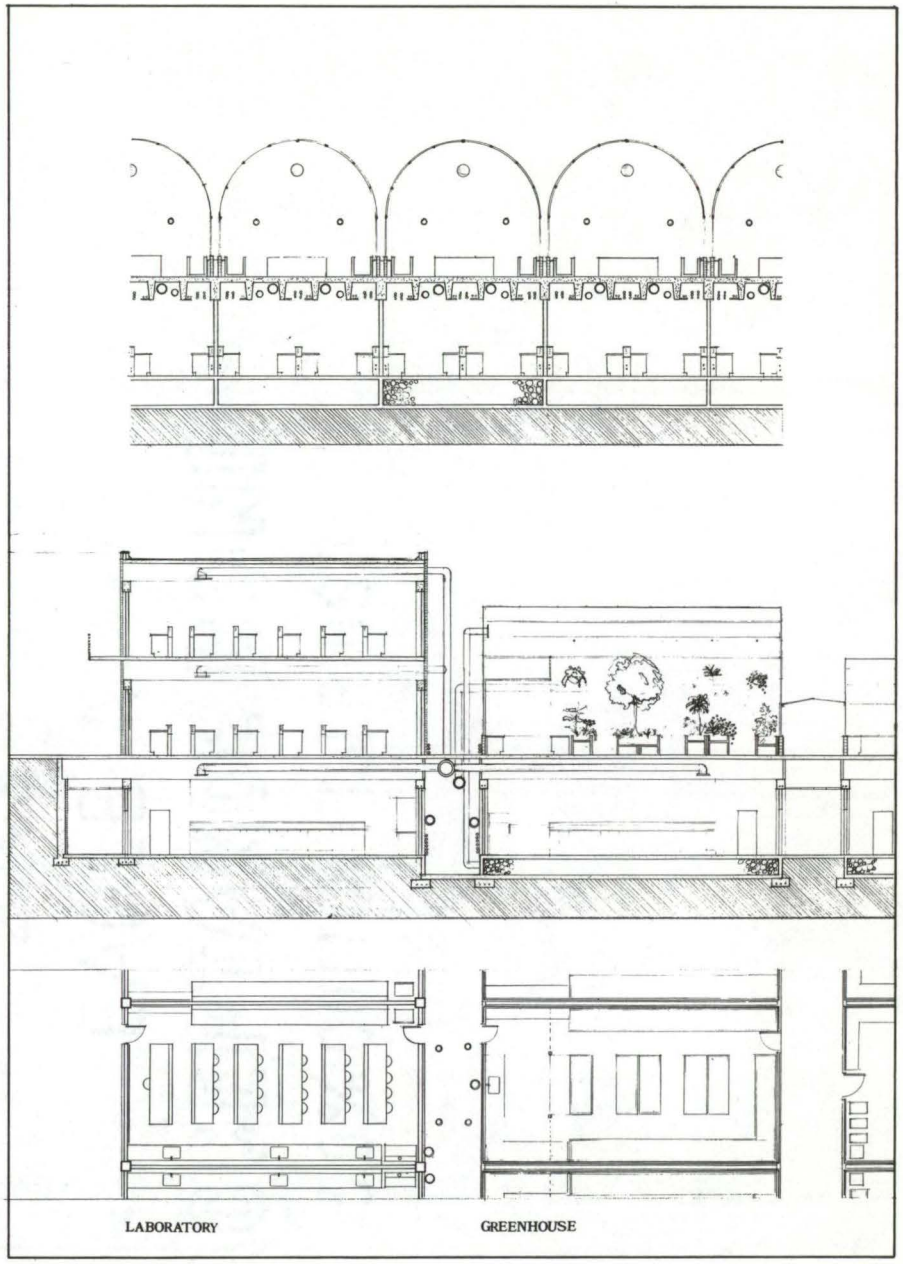
LEVEL 3

05 15 50

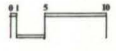


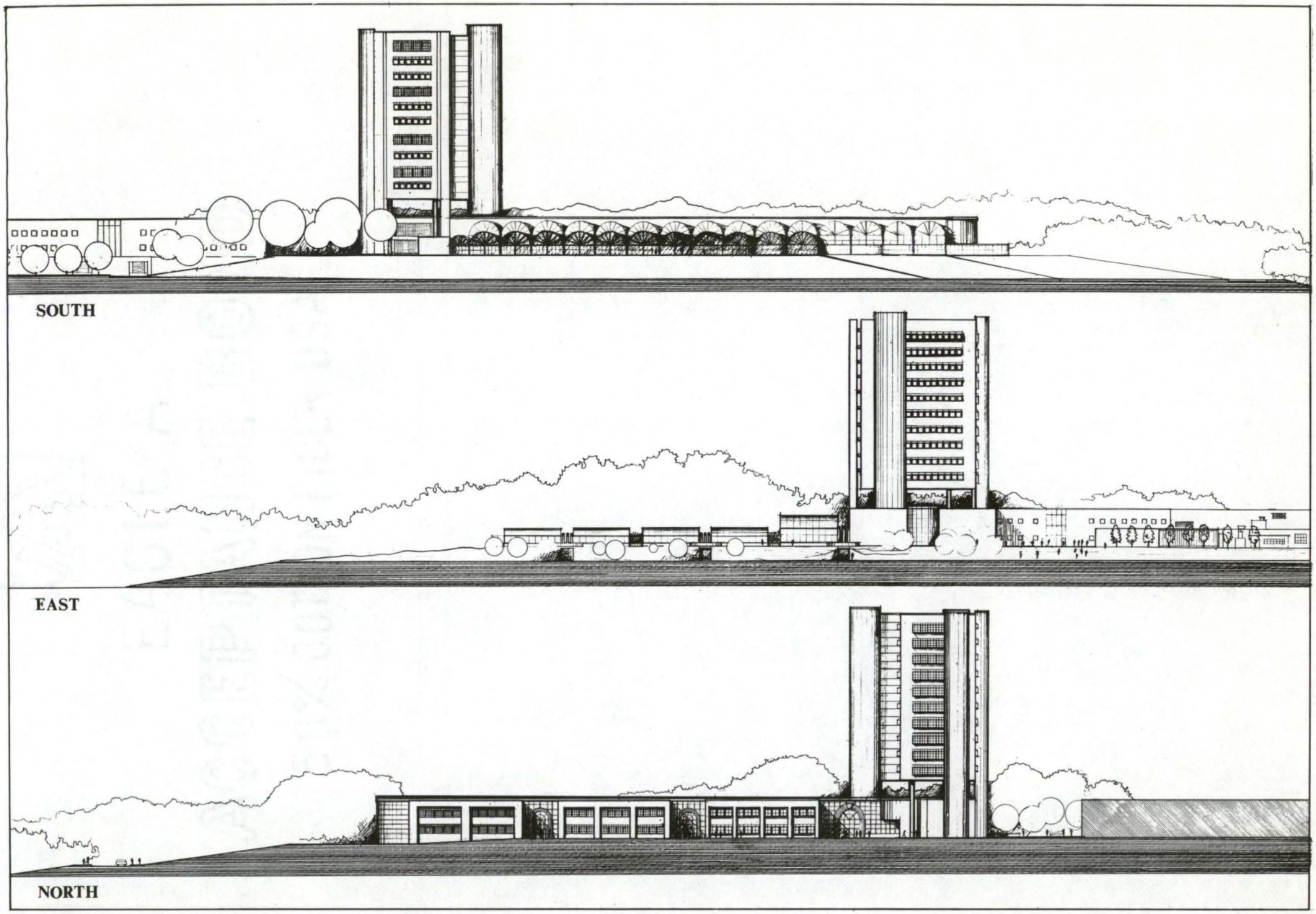
RESEARCH



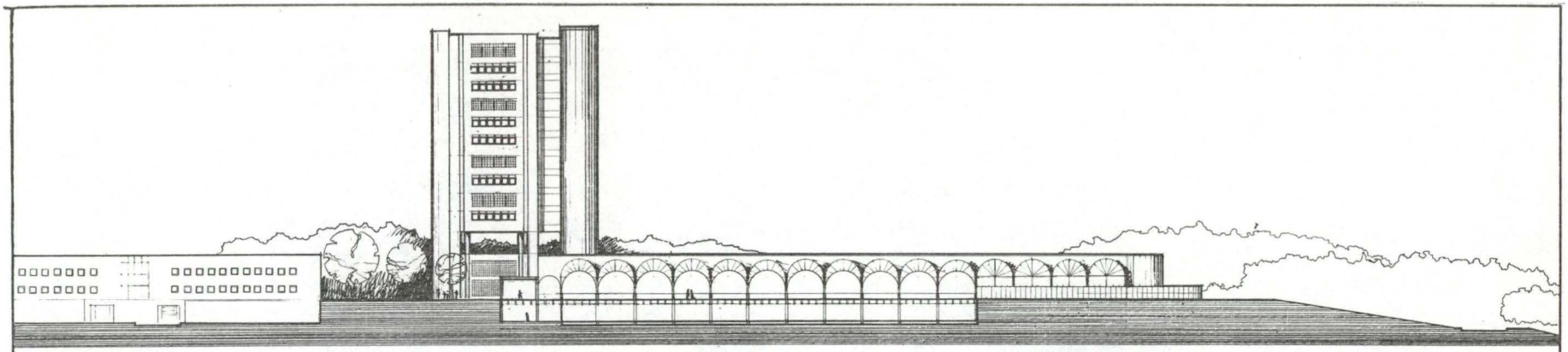


TEACHING

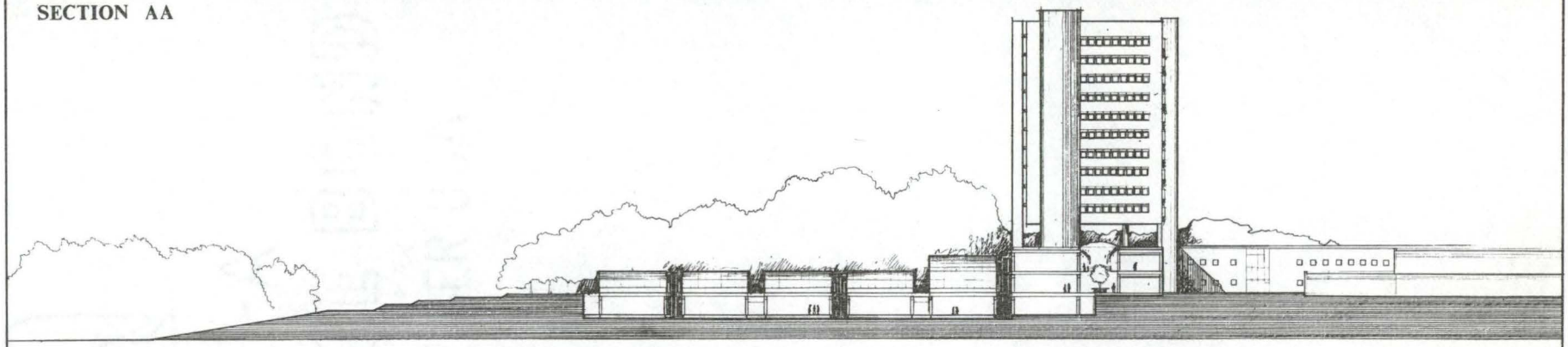




ELEVATIONS



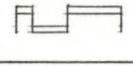
SECTION AA

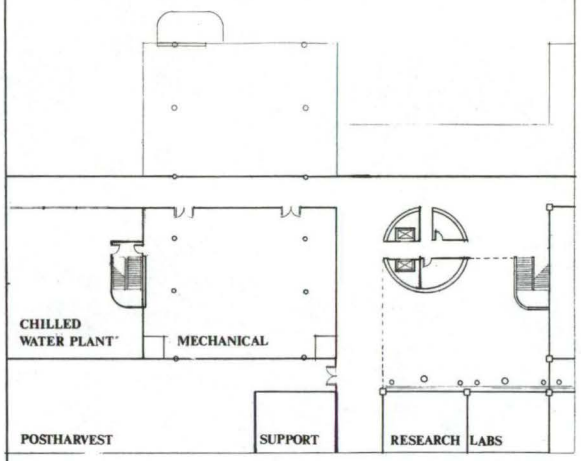


SECTION BB

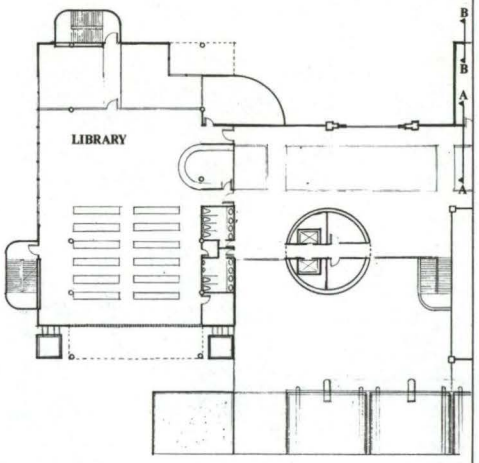
SECTION CC

SECTIONS





LEVEL 1



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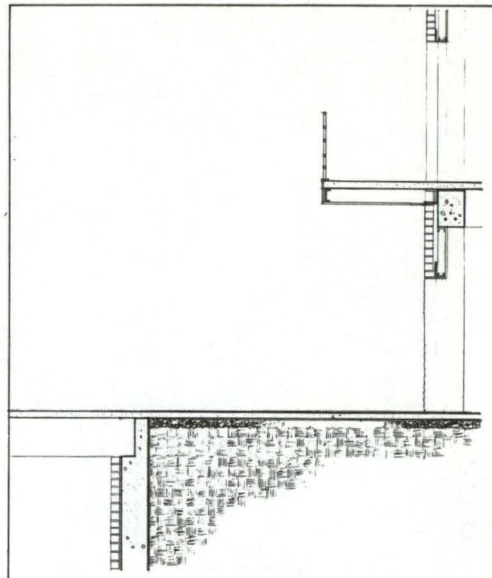

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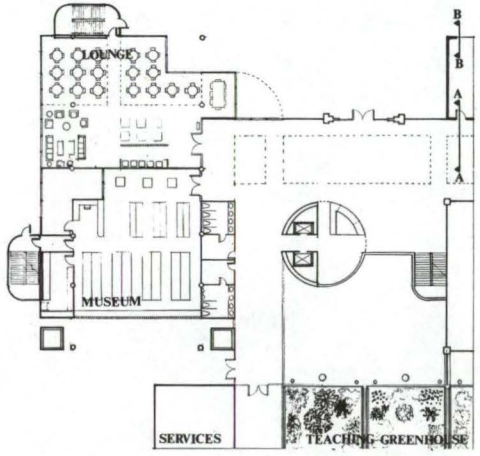
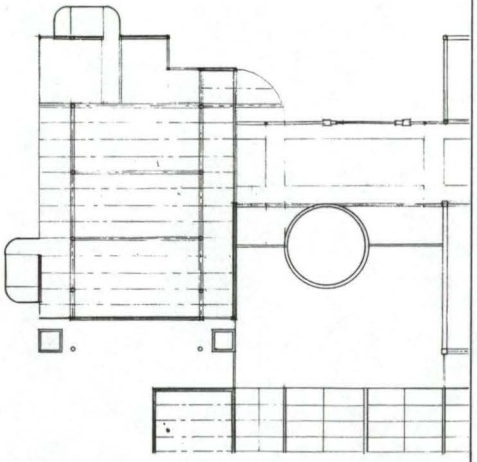
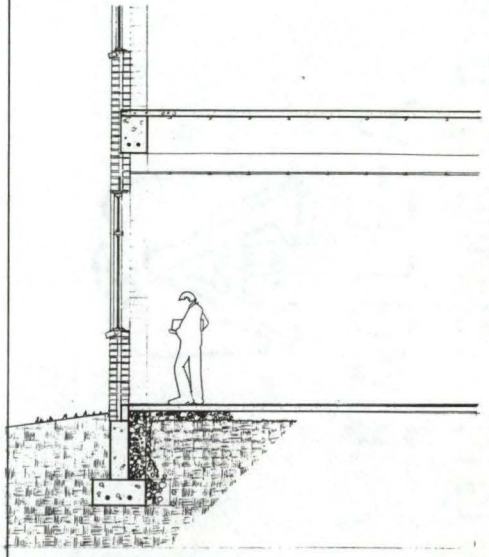


LEVEL 2

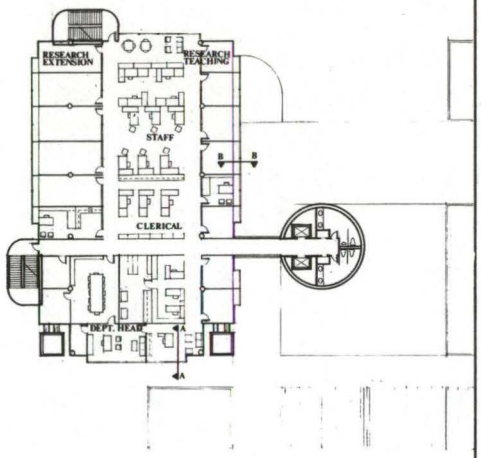


FRAMING

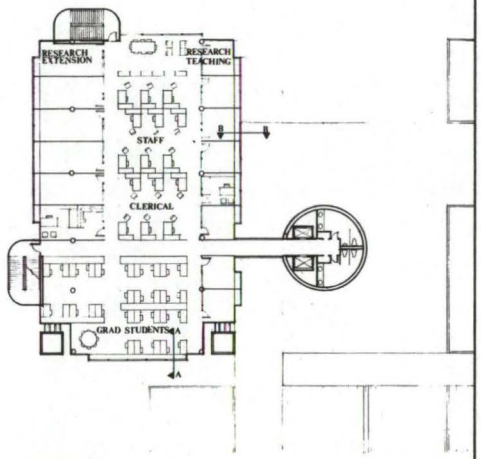


SECTION BB

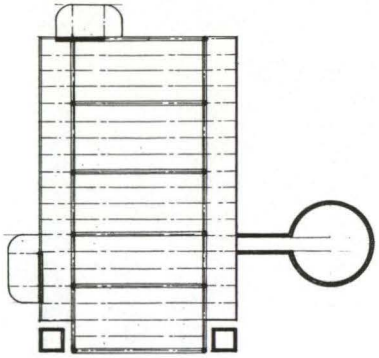
COMMON



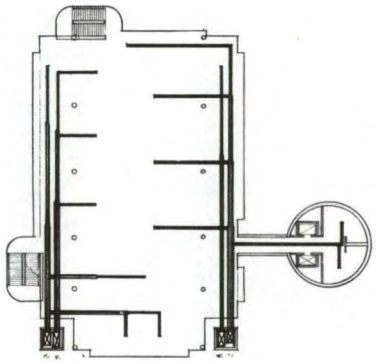
LEVEL TYPE A



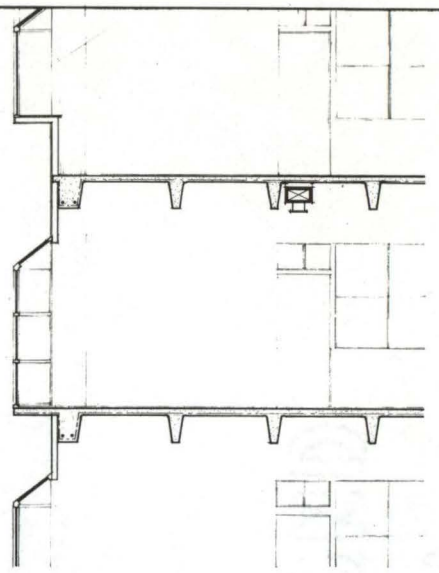
LEVEL TYPE B



STRUCTURAL



MECHANICAL



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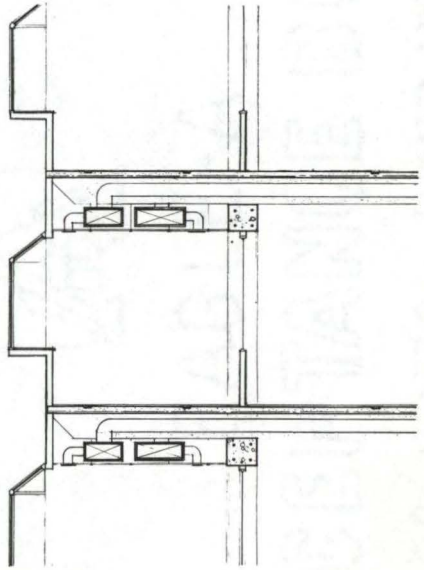

SECTION BB

TOWER

RESOURCES

"A New Focus on Princeton Campus." Architectual Record, March, 1980, Pages 81-88.

"Brick Machine" Architectual Forum, July/August 1968. pages 79-85.

"Machine for Scientific Research," Architectural Record, August 1980, pages 80-85.